

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

) Docket No. 72-22-ISFSI
)

PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel
Storage Installation)

) ASLBP No. 97-732-02-ISFSI
)
) June 28, 1999
)

**STATE OF UTAH'S OBJECTIONS AND RESPONSE TO
APPLICANT'S SECOND SET OF DISCOVERY REQUESTS
WITH RESPECT TO GROUPS II AND III CONTENTIONS**
[Addendum A may contain Proprietary Information]

The State responds to Applicant's Second Set of Discovery Requests dated May 13, 1999 with respect to Group II and III contentions, which include Utah E (Financial Assurance), H (Inadequate Thermal Design), L (Geotechnical), O (Hydrology), S (Decommissioning), U (Impacts of Onsite Storage not Considered), V (Transportation), W (Other Impacts not Considered), Z (No Action Alternative), AA (Range of Alternatives), DD (Ecology and Species), and GG (Failure to Demonstrate Cask-Pad Stability).

It should be noted that the State's response to this discovery request is with respect to Group II and Group III contentions and the State is still evaluating its case and accumulating the evidence needed to try these contentions. Furthermore, many of the Applicant's Interrogatories or Requests for Admission ask for the State's ultimate position on issues raised in a particular contention. However, there are a number of

reasons why the State is unable to fully response to some of the Applicant's discovery requests. First, the Applicant is still responding to RAI requests from the Staff. See various submittals from the Applicant in response to commitment resolutions the Applicant has made to the Staff to follow up on RAI responses. Second, NRC has reopened scoping on the Environmental Impact Statement and public comments may raise new NEPA issues. Third, the Staff may send out additional RAIs, especially with respect to the Environmental Report. Fourth, the Applicant and the State will file simultaneous responses to Group II and III discovery. Thus, the State will not have the opportunity to review the Applicant's responses before its own response is due. Fifth, the State is currently focusing most of its time and resources on the contentions in Group I, for which a hearing is scheduled in the fall of 1999. Hearings on Contentions in Groups II and III are not scheduled until fall 2000 and mid-2001. Thus, the State is still in the process of developing its case on the issues relating to the Contentions in Groups II and III. Accordingly, the State will answer requests from PFS as fully as possible given the status of the case and will, of course, supplement responses as appropriate.

GENERAL OBJECTIONS

These objections apply to the State of Utah's responses to all of the Applicant's Second Set of Formal Discovery Requests.

1. The State of Utah objects to the Applicant's instructions and definitions

on the grounds and to the extent that they request or purport to impose upon the State any obligation to respond in manner or scope beyond the requirements set forth in 10 CFR §§ 2.740, 2.741 and 2.742.

2. The State of Utah objects to Applicant's Request for Production of Documents to the extent that it requests discovery of information or documents protected under the attorney-client privilege, the attorney work-product doctrine and limitations on discovery of trial preparation materials and experts' knowledge or opinions set forth in 10 CFR § 2.740 or other protection provided by law. The State has provided PFS with a Privilege Log which identifies all documents subject to these privileges and protections and which the State reserves the right to supplement.

I. GENERAL INTERROGATORIES

GENERAL INTERROGATORY NO. 1. State the name, business address, and job title of each person who was consulted and/or who supplied information for responding to interrogatories, requests for admissions and requests for the production of documents. Specifically note for which interrogatories, requests for admissions and requests for production each such person was consulted and/or supplied information.

If the information or opinions of anyone who was consulted in connection with your response to an interrogatory or request for admission differs from your written answer to the discovery request, please describe in detail the differing information or opinions, and indicate why such differing information or opinions are not your official position as expressed in your written answer to the request.

RESPONSE TO GENERAL INTERROGATORY NO. 1.

The following persons were consulted and/or supplied information in responding to the discovery requests for Groups II and III Contentions in the

Applicant's Second and Third Discovery Requests. Their Declarations are attached hereto as Exhibit 1.

Utah Contentions E, S, Z, and AA
David A. Schlissel, Esq.
President, Schlissel Technical Consulting, Inc.
45 Horace Road Belmont, MA. 02478-2313

Michael F. Sheehan, Esq.
Economist and Financial Expert, Osterberg & Sheehan
33126 S.W. Callahan Road
Scappoose, Oregon 97056

Utah Contentions H, U, and V; and E and Z (limited to credible accident scenarios)
Marvin Resnikoff, Ph.D.
Senior Associate
Radioactive Waste Management Associates
526 West 26th Street, Room 517
New York, NY 10001

Utah Contentions L and GG
Walter Arabasz, Ph.D. (limited to Responses to Interrogatories Nos. 3 and 4, seismic hazard analysis)
Research Professor of Geology and Geophysics
University of Utah
Director, University of Utah Seismograph Stations
134 S. 1460 E., Room 705
Salt Lake City, Utah 84112-0110

M. Lee Allison, Ph.D. (limited to Responses to Admissions Nos. 1-4 and part of Interrogatory No. 5, seismic reflection analysis)
State Geologist and Director, Utah Geological Survey
1594 West North Temple
Salt Lake City, Utah 84114-6100

Steven F. Bartlett, Ph.D. (limited to collapsible soils, soil characterization and sampling program)
Research Project Manager, Research Division

Utah Department of Transportation
4501 South 2700 West
Salt Lake City, Utah 84114-8410

Farhang Ostadan, Ph.D.¹ (limited to soil dynamics and soil-structure interaction)
Consultant for Soil Dynamics and Soil-Structure Interaction
2 Agnes Street
Oakland, California 94618

Contention O
Donald A. Ostler
Director, Division of Water Quality
Department of Environmental Quality
288 North 1460 West
Salt Lake City, Utah 84116

Steven F. Bartlett, Ph.D. (limited to State's Response to Admission Request No. 3 (groundwater characterization))
Research Project Manager, Research Division
Utah Department of Transportation
4501 South 2700 West
Salt Lake City, Utah 84114-8410

General Discovery Requests and Utah Contention W
Denise Chancellor, Esq.
Assistant Attorney General
Utah Attorney General's Office
160 East 300 South, 5th Floor
Salt Lake City, Utah 84114-0873

¹ Dr. Ostadan's Declaration was prepared and signed prior to the extension of time granted for responses to Formal Discovery Requests for Groups II and III Contentions (originally to be filed June 18, 1999).

Contention DD

Frank P. Howe, Ph.D.² (limited to the peregrine falcon)
Non-Game Avian Program Coordinator
Utah Division of Wildlife Resources
Utah Department of Natural Resources
1594 West North Temple
Salt Lake City, Utah 84114

George V. Oliver³ (limited to the pocket gopher)
Chief Zoologist
Utah Natural Heritage Program
Utah Division of Wildlife Resources
Utah Department of Natural Resources
1594 West North Temple
Salt Lake City, Utah 84114

Merton A. Franklin⁴ (limited to Pohl's milkvetch and small spring parsley)
Botanist
Utah Natural Heritage Program
Utah Division of Wildlife Resources
Utah Department of Natural Resources
1594 West North Temple
Salt Lake City, Utah 84114

Chris S. Crnich, DVM (limited to livestock and farm produce)
Manager, Meat and Poultry Inspection Bureau
Utah Department of Agriculture

² Dr. Howe's Declaration was prepared and signed prior to the extension of time granted for responses to Formal Discovery Requests for Groups II and III Contentions (originally to be filed June 18, 1999).

³ Mr. Oliver's Declaration was prepared and signed prior to the extension of time granted for responses to Formal Discovery Requests for Groups II and III Contentions (originally to be filed June 18, 1999).

⁴ Mr. Franklin's Declaration was prepared and signed prior to the extension of time granted for responses to Formal Discovery Requests for Groups II and III Contentions (the Applicant and State initially agreed to an extension until June 25, 1999).

350 North Redwood Road
Salt Lake City, Utah 84116

In response to whether the information or opinions of anyone who was consulted in connection with the State's response to an interrogatory or request for admission differs from the State's written answer to the discovery request, the State is unaware of any such difference among those consulted.

In addition (and in response to General Interrogatory No. 3, Applicant's First Set of Formal Discovery Requests to the State dated April 2, 1999), the State has identified the following persons whom it expects to call as witnesses at the hearing; included herein as Exhibit 2 are the witnesses' resumes⁵ which provide answers to the questions of profession, employer, area of professional expertise, and educational and scientific experience:

Utah Contention E
Michael Sheehan, Esq., Ph.D.

Utah Contention H
Marvin Resnikoff, Ph.D.

Utah Contention L
Walter Arabasz, Ph.D. (seismic hazard analysis)
Lee Allison, Ph.D. (seismic reflection and capable faults)
Stephen Bartlett, Ph.D., P.E. (geotechnical and soils analysis)
Barry Solomon (capable faults)

Utah Contention S

⁵ Resumes for Dr. Resnikoff, Dr. Arabasz, Dr. Allison, and Barry Solomon have already been produced and are not included here.

Michael Sheehan, Esq., Ph.D.
David Schlissel, Esq.

Contention GG
Stephen Bartlett, Ph.D., P.E. (geotechnical and soils analysis)

II. GENERAL DOCUMENT REQUESTS

GENERAL REQUEST NO. 1. All documents in your possession, custody or control identified, referred to, relied on, or used in any way in (a) responding to the interrogatories and requests for admissions set forth in Applicant's First Set of Formal Discovery Requests to Intervenors State of Utah and Confederated Tribes, (b) responding to the following interrogatories and requests for admissions in this document, or (c) responding to the any subsequent interrogatories and requests for admissions filed with respect to the State's and/or Confederated Tribes Contentions as admitted by the Board.

RESPONSE TO GENERAL REQUEST NO. 1.

See responses to specific Document Requests below.

III. BOARD CONTENTION 3 (UTAH E/CONFEDERATED TRIBES F) FINANCIAL ASSURANCE

The State has obtained certain information from the Applicant under a confidentiality and non-disclosure agreement. The agreement provides that the State may use information obtained under the agreement in an NRC proceeding provided the State files a proprietary pleading relevant to that information. Other information used in this response may already have been submitted by the Applicant to NRC as a proprietary document. In the State's responses to Contention E, Requests for Admissions and Interrogatories, and also with respect to Interrogatory responses to certain parts of Contentions S and AA, the State has discussed information obtained

under the State-PFS confidentiality agreement or from the proprietary submittals to the NRC. Accordingly, the State files its answer to the foregoing discovery requests as a proprietary pleading; however, the State makes no representation whether or not any of this information should be treated as confidential. The State and the Applicant have agreed that the Applicant will file a justification of its proprietary or confidentiality claim with the Staff or the Board or, alternatively, relinquish its proprietary claim. If the Applicant relinquishes a claim of confidentiality the Applicant will serve the relevant portion of the State's proprietary response on those parties who are not now being served with the State's proprietary response.

The State's responses that may contain proprietary information are appended hereto as Addendum A and are fully incorporated herewith. As noted in the Mailing Certificate, the proprietary portion of the State's response will not be served on those parties whom the State understands have not entered into a confidential and non-disclosure agreement with the Applicant or who are not otherwise privy to this information.

C. Document Requests - Utah E/Confederated Tribes F

DOCUMENT REQUEST NO. 1 - UTAH E: All documents related to the claims raised by the State and/or the Confederated Tribes, as admitted by the Board, in Utah Contention E and Confederated Tribes F (including those claims raised in Castle Rock Contention 7, as incorporated by Confederated Tribes).

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH E:

To date, the State has reviewed the License Application, the Environmental

Report, the Safety Analysis Report, the Private Fuel Storage LLC Business Plans, the ERI "Utility At-Reactor Spent Fuel Costs for the Private Fuel Storage Facility Cost Benefit Analysis" and the related series of May and June 1997 memoranda from Eileen Supko to Scott Northard and John Parkyn, PFS's responses to the NRC's Requests for Additional Information, and the other documents obtained from PFS through discovery. The State has also reviewed the following publicly available documents relating to Contention E:

Sandquist, GM et al, "Exposures and Health Effects from Spent Fuel Transportation," Rogers & Associates for the Department of Energy, RAE-8339/12-1, November 29, 1985.

Schmidt, EW et al, "Shipping Cask Sabotage Source Term Investigation," Battelle Columbus Laboratories, NUREG/CR-2472, December 1981.

Wilmot, EL, "Transportation Accident Scenarios for Commercial Spent Fuel," SAND80-2124, February 1981.

Madsen, MM, et al, "RADTRAN III," Sandia National Laboratory, SAND84-0036, February 1986.

"The Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste," prepared by Planning Information Corporation for the Nevada Nuclear Waste Project Office, September 1996, available at the website of the State of Nevada Nuclear Waste Project Office.

Non-publicly available documents related to Contention E that were not obtained from PFS are located at Ms. Nakahara's office at the Department of Environmental Quality.

DOCUMENT REQUEST NO. 2 - UTAH E: All documents, data or other information generated, reviewed, considered or relied upon by Michael Sheehan, or any other expert or consultant assisting the State and/or the Confederated Tribes, in connection with respect to Utah Contention E and Confederated Tribes F (including those claims raised in Castle Rock Contention 7, as incorporated by Confederated Tribes).

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH E:

The State objects to this Request and over broad and to the extent that the Request requires production of privileged documents. Notwithstanding these objections, Dr. Sheehan has reviewed, considered or relied upon documents filed in this proceeding, such as pleadings and exhibits thereto, orders, hearing transcripts, the PFS license submittal as amended, and PFS's responses to RAIs. He has also reviewed, considered or relied upon documents produced during informal and formal discovery, particularly those documents specifically referred to in responses to discovery requests for Contentions E, S, Z or AA. Examples of additional documents relevant to Contentions E, S, Z or AA that Dr. Sheehan generated, reviewed, considered or relied upon include, but are not limited to, the following:

Correspondence and Memos (PFS documents produced under discovery).

Miscellaneous PFS documents relating to Decommissioning (bates nos. 9211-9228 produced by PFS under discovery).

Miscellaneous Newspaper and Wire Service clippings.

RW, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* RW 0510 December 1998.

RW, *Viability Assessment of a Repository at Yucca Mountain: Overview* 0508 December 1998.

Oregon Office of Energy, *Staff Evaluation of PGE (Trojan) ISFSI* January 27, 1999.

RW, *Acceptance Priority Ranking & Annual Capacity Report* March 1995.

TRW for RW, *At Reactor Dry Storage Issues* Revision 1 December 10, 1993.

TRW for RW, *CRWMS Modular Design/Construction and Operation Options Report* Revision 02 December 18, 1998.

DOE, 2. *Impacts of Electric Power Industry Restructuring on the U.S. Nuclear Power Industry* March 11, 1999.

All non-privileged documents not already produced, with the exception of publically available documents, will be available for inspection and copying in Ms. Nakahara's office.

IV. BOARD CONTENTION 6 (UTAH H) INADEQUATE THERMAL DESIGN

A. Requests for Admission - Utah H

ADMISSION REQUEST NO. 1 - UTAH H: Do you admit that the long-term thermal design limit for the HI-STORM 100 storage cask is an annual average ambient temperature of 80 °F.?

RESPONSE TO ADMISSION REQUEST NO. 1 - UTAH H:

Admit.

ADMISSION REQUEST NO. 2 - UTAH H: Do you admit that the long-term thermal design limit for the TranStor storage cask is an annual average ambient temperature of 75 °F.?

RESPONSE TO ADMISSION REQUEST NO. 2 - UTAH H:

Admit.

ADMISSION REQUEST NO. 3 - UTAH H: Do you admit that the short-term thermal design limits for both the HI-STORM 100 and TranStor storage casks is a 24-hour average ambient temperature of 100 °F.?

RESPONSE TO ADMISSION REQUEST NO. 3 - UTAH H:

Admit.

ADMISSION REQUEST NO. 4 - UTAH H: Do you admit that an annual average ambient temperature of 75 °F. or more has never been recorded for any location in Skull Valley?

RESPONSE TO ADMISSION REQUEST NO. 4 - UTAH H:

The State does not have enough information to admit this request, but neither does the State have any basis to deny it.

ADMISSION REQUEST NO. 5 - UTAH H: Do you admit that an average ambient temperature over a period of 24 hours of 100 °F. or more has never been recorded for any location in Skull Valley?

RESPONSE TO ADMISSION REQUEST NO. 5 - UTAH H:

The State does not have enough information to admit this request, but neither does the State have any basis to deny it.

ADMISSION REQUEST NO. 6 - UTAH H: Do you admit that an annual average ambient temperature of 75 °F. or more has never been recorded for any location in Utah?

RESPONSE TO ADMISSION REQUEST NO. 6 - UTAH H:

The State objects to this request as overbroad because the Applicant is requesting temperature information recorded for "any location in Utah," rather than confining its request to Skull Valley. Notwithstanding this objection, the State does not have enough information to admit this request, but neither does the State have any basis to deny it.

ADMISSION REQUEST NO. 7 - UTAH H: Do you admit that an average ambient temperature over a period of 24 hours of 100 °F. or more has never been recorded for any location in Utah?

RESPONSE TO ADMISSION REQUEST NO. 7 - UTAH H:

The State objects to this request as overbroad because the Applicant is requesting temperature information recorded for "any location in Utah," rather than confining its request to Skull Valley. Notwithstanding this objection, the State does not have enough information to admit this request, but neither does the State have any basis to deny it.

ADMISSION REQUEST NO. 8 - UTAH H: Do you admit that the short-term design temperature limit for the concrete used in the PFSF spent fuel storage casks is 350 °F.?

RESPONSE TO ADMISSION REQUEST NO. 8 - UTAH H:

The State objects to this Request as ambiguous and vague because the Applicant has not clarified which of the two storage casks under consideration by PFS it is referring to in this request for admission. Notwithstanding this objection, the State denies this request. If the Applicant is referring to the HI-STORM spent fuel storage cask, the State responds that the short-term design temperature limit of 350 degrees F applies only if, according to the American Concrete Institute publication, ACI-349, Appendix A, the cement aggregate mix is appropriate. PFS has not clearly committed to adhering to ACI-349.

ADMISSION REQUEST NO. 9 - UTAH H: Do you admit that the long-term design temperature limit for the concrete used in the PFSF spent fuel storage

casks is 300 °F.?

RESPONSE TO ADMISSION REQUEST NO. 9 - UTAH H:

The State objects to this Request as ambiguous and vague because the Applicant has not clarified which of the two storage casks under consideration by PFS it is referring to in this request for admission. Notwithstanding this objection, the State denies this request. If the Applicant is referring to the TranStor spent fuel storage cask, the State responds that the short-term design temperature limit of 300 degrees F applies only if, according to the American Concrete Institute publication, ACI-349, Appendix A, the cement aggregate mix is appropriate. PFS has not clearly committed to adhering to ACI.

B. Interrogatories - Utah H

INTERROGATORY NO. 1 - UTAH H: Identify, and set forth fully the supporting data and bases for, the maximum annual average ambient temperature and the maximum average ambient temperature over a 24-hour period that the State claims has been recorded for any location in Skull Valley.

RESPONSE TO INTERROGATORY NO. 1 - UTAH H:

The State objects to Interrogatory No. 1 because the Applicant may locate this information as well as the State. Notwithstanding this objection, the State is in the process of studying this matter, and will supplement this response appropriately.

INTERROGATORY NO. 2 - UTAH H: To the extent that the State does not admit Request No 6, what does the State contend is the maximum annual average ambient temperature recorded in Utah? Identify and set forth fully the data and bases supporting the State's contentions.

RESPONSE TO INTERROGATORY NO. 2 - UTAH H:

The State objects to Interrogatory No. 2 because it is overbroad and burdensome, and because the Applicant may locate this information as well as the State. Notwithstanding these objections, the State is in the process of studying this matter, and will supplement this response appropriately.

INTERROGATORY NO. 3 - UTAH H: To the extent that the State does not admit Request No 7, what does the State contend is the maximum average ambient temperature over a 24-hour period recorded in Utah? Identify and set forth fully the data and bases supporting the State's contentions.

RESPONSE TO INTERROGATORY NO. 3 - UTAH H:

See Response to Interrogatory No. 2.

INTERROGATORY NO. 4 - UTAH H: Identify, and set forth fully the supporting data and bases, the maximum annual average ambient temperature and the maximum average ambient temperature over a 24-hour period that the State claims could reasonably be expected to occur at the PFSF site

RESPONSE TO INTERROGATORY NO. 4 - UTAH H:

The State is in the process of studying this matter. The State has not calculated the maximum annual average ambient temperature and the maximum average ambient temperature over a 24-hour period. These temperatures cannot be determined by simple reference to historical meteorological measurements. The "ambient" or "surrounding" temperature conditions are altered when the independent spent fuel storage installation ("ISFSI") pad is constructed and heat generating casks are placed on the pad. The ambient temperature for the pad, plus closely spaced casks, will be much

higher than the ambient conditions without the pad and casks, and will exceed previously recorded temperatures in Skull Valley. For purposes of the hearing, the State will calculate the ambient temperatures under normal and off-normal conditions, taking into account the temperature of the concrete pad and the heat output of neighboring casks.

INTERROGATORY NO. 5 - UTAH H: To the extent that the State does not admit Request Nos. 8 and 9, what does the State contend are the maximum short-term and long-term temperature limits for the concrete used in the TranStor and HI-STORM spent fuel storage casks? Identify and set forth fully the data and bases supporting the State's contentions.

RESPONSE TO INTERROGATORY NO. 5 - UTAH H:

See Response to Interrogatory No. 4.

C. Document Requests - Utah H

DOCUMENT REQUEST NO. 1 - UTAH H: All documents related to the claims raised by the State, as admitted by the Board, in Contention H.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH H:

The State has produced all documents, not privileged, related to State claims raised in Contention H. These are available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State.

DOCUMENT REQUEST NO. 2 - UTAH H: All documents, data and information generated, reviewed, considered or relied upon by Marvin Resnikoff, or any other expert or consultant assisting the State, in connection with respect to Utah Contention H.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH H:

VSC-24, TSAR, Rev. 0, prepared by Pacific Sierra Nuclear Associates, Docket No. 72-1007, section 4.4.1.1 [Sierra Nuclear Corporation casks]; and

VSC-24, TSAR, "Design Calculations, VSC-24 Airflow Analysis, Rev. 3," 1/8/93 [Sierra Nuclear Corporation casks].

DOCUMENT REQUEST NO. 3 - UTAH H: All documents, other than U.S. Weather Bureau data, containing temperature measurements that indicate or tend to indicate what the maximum annual average ambient temperature anywhere in Skull Valley has been or would be.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH H:

The State is in the process of studying this matter, and will supplement this response appropriately.

DOCUMENT REQUEST NO. 4 - UTAH H: All documents, other than U.S. Weather Bureau data, containing temperature measurements that indicate or tend to indicate what that the maximum average ambient temperature over a 24-hour period anywhere in Skull Valley has been or would be.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH H:

See response to Document Request No. 3 above.

DOCUMENT REQUEST NO. 5 - UTAH H: All documents containing temperature data and other data that support the State's contentions in Interrogatory Nos. 1-5.

RESPONSE TO DOCUMENT REQUEST NO. 5 - UTAH H:

See response to Document Request No. 3 above.

V. BOARD CONTENTION 8 (UTAH L) GEOTECHNICAL

A. Requests for Admission - Utah L

ADMISSION REQUEST NO. 1 - UTAH L: Do you admit that the Geomatrix study identifies the faults in the vicinity of the PFS facility that could result in the greatest vibratory ground motion at the PFS site?

RESPONSE TO ADMISSION REQUEST NO. 1 - UTAH L:

Admission No. 1 is denied.

ADMISSION REQUEST NO. 2 - UTAH L: Do you admit that the Geomatrix study identifies the faults in the vicinity of the PFS facility that could result in the greatest ground displacement at the PFS site?

RESPONSE TO ADMISSION REQUEST NO. 2 - UTAH L:

Admission No. 2 is denied.

ADMISSION REQUEST NO. 3 - UTAH L: Do you admit that the estimated peak horizontal ground acceleration of 0.40g for the 1000-year return period, using a probabilistic seismic hazards approach, is accurate? (PFS Request for Exemption to 10 CFR 72.102(f)(1), April 2, 1999)

RESPONSE TO ADMISSION REQUEST NO. 3 - UTAH L:

Admission No. 3 is denied.

ADMISSION REQUEST NO. 4 - UTAH L: Do you admit that the estimated displacement due to faulting of <0.1 cm for the 2000-year return period, using a probabilistic seismic hazards approach, is accurate? (Geomatrix study, pg. 109)

RESPONSE TO ADMISSION REQUEST NO. 4 - UTAH L:

Admission No. 4 is denied.

B. Interrogatories - Utah L

INTERROGATORY NO. 1 - UTAH L: To the extent that the State denies Request for Admission No. 1, identify each fault that the State contends could result in greater ground motion at the PFS site than those identified in the Geomatrix study, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 1 - UTAH L:

As more fully described below, the Geomatrix conclusions are based on data, data processing, and interpretations that are either inadequate or in error and thus do not provide the State the necessary means of identifying each fault that could result in greater ground motion than those identified in the Geomatrix study. Although Bay Geophysical acquired and interpreted the seismic reflection lines, Geomatrix integrated that information into the final fault evaluation study. Thus, when the State in this response makes reference to Geomatrix, the response also encompasses the work performed by Bay Geophysical. Furthermore, additional seismic reflection lines shot by oil companies in the area are commercially available. See Index Map, entitled *Commercially Available Seismic Reflection Lines, Skull Valley, Utah*, June 1999, listed in Response to Document Request No. 3 below. Geomatrix used only one of these existing lines in their interpretations (GSI-UT-34). The other lines could provide crucial information about location, extent, offsets, and age of faulting.

1. Inadequate Correlation of Faults. PFS's contractors identified up to 24 potentially active faults on individual seismic reflection lines. The correlations of faults between seismic lines are sporadic and appear to be speculative. For example, in the Bay Geophysical Associates, Inc.'s Final Report, *High Resolution Seismic Shear Wave Reflection Profiling for the Identification of Faults at the Private Fuel Storage Facility Skull Valley, Utah*, dated January 1999, Interpreted Time Sections PFSF-98-A

(Fig. 20) and PFSF-98-B (Fig. 21) fault D1 on line PFSF-98-A ("line A") offsets the Q/T, Qp, and younger reflectors, but on line PFSF-98-B ("line B"), fault D1 is shown as terminating below reflector Q/T. Conversely, fault E1 offsets reflector Q/T on line PFSF-98-B but terminates below it on line PFSF-98-A. A more plausible explanation might be that fault D1 on line A is better correlated with fault E1 on line B. Overall, the correlations are not geologically reasonable, nor supported by any specific evidence, but rather simply straight lines connecting point locations. Geomatrix provides little information on the length or orientation of the faults on the seismic lines. Ground motion is generally determined from the length of rupture of the fault; so without knowing the fault length, an accurate estimate of the ground motion to be expected cannot be determined, either by the State or by Geomatrix.

2. Incomplete Identification of Offsets on Faults. Geomatrix estimates offsets on faults only where they are identified on seismic reflection lines. Displacements are likely to vary along the length of the faults. Geomatrix provided no information on offsets, particularly maximum offsets, along the entire length of the faults it identified.

3. Inappropriate Processing of Seismic Reflection Data. Geomatrix's inappropriate use of "statics" and "smoothing" processing on the seismic reflection lines resulted in minimizing or obscuring fault offsets. Thus, offsets on identified faults may be underestimated; other faults may not have been recognized. Geomatrix responded to the State's Interrogatory No. 1 on this issue that the "Traces smoothed"

notation "simply reflects the blending of adjacent color pixels ... [and] had no effect on the processing and interpretation of the data." Applicant's Objections and Non-proprietary Responses to State's First Requests for Discovery, dated April 21, 1999, at 41. The latter part of Geomatrix's statement is incorrect. It is widely and generally accepted in the geophysical profession that "smoothing" enhances continuity of reflectors and diminishes the recognition of discontinuities such as faults. That is precisely the reason "smoothing" is used as a processing tool, albeit for other situations, where identification of faulting is not the purpose of the study. Geomatrix's claim that it is simply a blending of color pixels is disingenuous in that the pixels (whether color or not) are the actual data that need to be analyzed. Blending or smoothing of them obliterates fault offsets.

In response to State's Interrogatory No. 2, the Applicant claims that trim statics processing facilitates identification of significant geologic features, such as faulting, but in the same answer the Applicant offers the contradictory statement that the "trim statics compensate for trace-to-trace near surface velocity aberrations that create small travel time differences..." *Id.* at 41-42. The Applicant notes that an implicit assumption in the use of trim statics is that the stratigraphy is consistent over a lateral distance of approximately 45 feet. The Applicant argues that the use of this processing is valid because its contractors found a location where the technique appeared to be consistent with subsurface borings. An unfortunate side effect of using trim statics,

however, is that where the stratigraphy is not laterally consistent, such as where it is offset by a fault, the use of trim statics processing will diminish, obscure, or eliminate the evidence of the faulting. Fault offsets may therefore be larger than those interpreted by Bay Geophysical and used by Geomatrix.

4. Miscorrelation of Seismic Reflection Lines. At a number of locations on the seismic reflection lines, the interpreter incorrectly jumped across reflectors or arbitrarily shifted the correlation horizon to a different reflector. Two examples are at shot point 1930, line A, Qp (yellow) horizon; and shot point 1160, line A, Q/T (blue) horizon. See Bay Geophysical Associates, Inc.'s Final Report, *High Resolution Seismic Shear Wave Reflection Profiling for the Identification of Faults at the Private Fuel Storage Facility Skull Valley, Utah*, dated January 1999, Interpreted Time Section PFSF-98-A (Fig. 20). Because the reflectors are miscorrelated, the offsets across faults are in error. Such errors are difficult to quantify on the Bay Geophysical data because the seismic reflector lines are parallel to subparallel only; there are no intersecting lines with which to close an interpretation loop and find internal errors.

5. Fault Displacements. Geomatrix argues that fault displacements are so minor that the proposed facility can be designed to accommodate them. However, this interpretation is drawn from faulty data and ad hoc conclusions. First, the fault offsets determined by Geomatrix may be in error because the seismic reflection data is processed and interpreted incorrectly (see discussion in 1, above). Second, Geomatrix

makes an assumption that the offsets represent multiple ruptures of the faults, which implies that each rupture accounts for only a part of the measured offset. This conclusion is not justified or supported by any data. Given the high density of active faults discovered by Geomatrix in the PFS site area, it is not unreasonable to conclude that they are part of a larger fault system, any strand of which may develop offset during an earthquake. Thus, the offset on each fault could represent an individual earthquake resulting in large displacement on selected faults rather than multiple events resulting in smaller displacements on one or more faults as Geomatrix proposes. In such a case, the earthquake magnitude (and corresponding ground shaking and ground displacement) would be greater than that envisioned by Geomatrix.

6. Procedures and Quality Assurance. There are two fundamental defects relating to procedures and quality assurance. First, Bay Geophysical's Final Report describes procedures for carrying out correlations and interpretations of seismic reflection data. Among these procedures are the requirements (Appendix A, General Procedures for Seismic Interpretation, page 3) that picked horizons be tied at the intersection with each crossing line and that misties can indicate interpreter error, navigation problems, map errors or migration (processing) problems. The Report states, "Tying loops at the intersection assures that each horizon has been accurately identified and picked on each seismic line. The procedure produces an internally consistent interpretation of each horizon." Id. The State agrees with this last

statement and notes that it is a generally accepted procedure in seismic interpretation. However, Bay Geophysical was unable to carry out this procedure because no intersecting seismic reflection lines were acquired. This serious deficiency in the design of the seismic reflection survey means that each line was interpreted independently, allowing for mistakes and erroneous determination of fault offsets as warned by Bay Geophysical in their Quality Assurance Plan.

Second, Bay Geophysical's procedures for interpretation also call for the use of velocity and interval velocity information (Appendix A, General Procedures for Seismic Interpretation, pages 1 & 6). The seismic reflection data provided to the State does not include velocity or interval velocity information; so the validity of these claims cannot be assessed. Bay Geophysical describes broad estimates of velocities in their Final Report (page 15) of 500-800 feet per second down to the Qp horizon; 1000-1500 feet per second in the Qp to Q/T interval; and about 2000 feet per second below the Quaternary (i.e., below the Q/T horizon). In Table 1 of the Final Report Bay Geophysical calculates fault displacements using 1100 feet per second for displacement of the Q/T horizon which is near the low end of the velocity range. If it used 1500 feet per second (the upper range of estimated velocities), the calculated fault displacements would be 36% greater than those shown by Bay Geophysical and used by Geomatrix to argue the displacements are inconsequential. If it used 2000 feet per second (as identified by Geomatrix, Vol. III - appendix F, page F-4), the displacements

would be about 82% greater than presented.

By using generalized average and interval velocities for its interpretations, Bay Geophysical violated its own Quality Assurance guidelines, resulting in a less valid interpretation. The use of shotpoint-specific velocity information would allow better recognition of geologic units with different velocities (and thus different composition or age) across faults. This is a valuable tool to aid in interpretation especially in areas where data quality is poor, where reflection lines are not tied by intersecting lines, where bedrock offsets are not easily recognized or the geologic sequence is not fully understood, all conditions that exist in this case.

7. Obscuration of faults by surficial deposits and erosion. There are features on seismic reflection line PFSF-98-B that the State interprets as channels and alluvial fan deposits that eroded and replaced more continuous strata. The heterogeneous nature of the sediments in the near surface may account for the poor quality of data on this line. Geomatrix and Bay Geophysical label the seismic line as poor quality southwest of shotpoint 1000 and identify no faults in that interval. The channel and fan deposits could be derived from the nearby Hickman Knolls and be very young. The channeling would have eroded away shallow evidence of faults in this area. Consequently, there may be additional unrecognized active and capable faults under the most recent channel and fan deposits in this area that need to be identified and evaluated.

8. Lack of resolution of features. Bay Geophysical notes in its Final Report, at

p. 15 and Table 2, that the peak frequency of reflections ranges from between 100 and 150 hertz. Bay Geophysical calculated the resolutions for the frequency range given rock velocities of 500 - 1000 feet per second. Yet, it uses 1100 feet per second in Table 1 to calculate vertical displacement on faults. Using the computation methods described in the Final Report at p. 14 and Table 2, the State computed that for 1100 feet per second, the smallest feature resolvable increases to 1.83 - 2.75 feet for 100 to 150 hertz. In reviewing Table 1 of the Final Report it is clear that most of the calculated displacements are just at or below the limit of resolution. If a 1500 per second velocity as described by Bay Geophysical is used, then the smallest resolvable feature is 2.5 - 3.75 feet. In other words, fault offsets up to 3.75 feet may not be recognized on the seismic reflection lines because they are at the limit of resolution of the data. The State believes fault offsets of that size are significant and need to be identified and evaluated. It is questionable whether the Geomatrix study does that adequately.

In addition, the inappropriate processing of the seismic reflection data described above flattens the data and reduces apparent fault offsets. Combining low resolution with flattened data means that fault offsets of much greater than 3 to 4 feet may be completely overlooked.

INTERROGATORY NO. 2 - UTAH L: To the extent that the State denies Request for Admission No. 2, identify each fault that the State contends could result in greater ground displacement at the PFS site than those identified in the Geomatrix study, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 2 - UTAH L:

See response to Interrogatory No. 1.

INTERROGATORY NO. 3 - UTAH L: Identify and fully explain any deficiencies claimed by the State in the probabilistic seismic hazards assessment for both vibratory ground motion and surface displacement conducted for the PFS facility, as detailed in the Geomatrix study and the April 2, 1999 PFS Request for Exemption to 10 CFR 72.102(f)(1), and the bases therefor.

RESPONSE TO INTERROGATORY NO. 3 - UTAH L:

The State objects to Interrogatory No. 3 because no exemption request has been granted to the Applicant to allow it to conduct a probabilistic seismic hazards assessment; under current regulations, the Applicant must conduct a deterministic analysis. Notwithstanding this objection, the State provides the following response.

- A. Inadequate justification for qualifying for the Frequency-Category-1 design basis ground motion (1,000-year return period).**

In the PFS "Request for Exemption to 72.102(f)(1) Seismic Design Requirement for the Private Fuel Storage Facility," dated April 2, 1999 (hereafter "Exemption Request"), PFS requests the NRC Staff approve a change in the methodology to calculate the design ground motions for the proposed Private Fuel Storage Facility. The change entails using a probabilistic, risk-informed approach instead of the deterministic approach currently required by 10 CFR § 72.102(f)(1). PFS further requests the Staff approve PFS's calculation of the probabilistic design ground motions using a return period of 1,000 years "based on dose consequences of accidents at the

PFSF and consideration of relative risk." Exemption Request at 2. As discussed below, the analysis of dose consequences of hypothetical accidents at the PFS site, described and referenced in the Exemption Request, does not provide adequate justification for the use of a 1,000-year return period.

The bases for PFS's request to use a 1,000-year return period include references to:

- (a) the risk-informed approach of 10 CFR Part 60 for high-level radioactive waste repositories;
- (b) NRC's rulemaking plan for siting and design of dry cask independent spent fuel storage installations under 10 CFR Part 72, which proposed changing the licensing regulations for ISFSIs to allow the option of using a probabilistic methodology for seismic hazard evaluations; and
- (c) a previous NRC decision relating to DOE's request for exemption to 10 CFR § 72.102(f)(1) for an ISFSI at the Idaho National Engineering and Environmental Laboratory.

Exemption Request at 2-6. The level of consequences of accidents is central to a risk-informed graded approach under which structures, systems, and components ("SSCs") are allowed to be designed, in the case of earthquakes, to either Frequency-Category-1 design basis ground motions (1,000-year return period) or Frequency-Category-2 design basis ground motions (10,000-year return period). *See, e.g.,* Exemption Request at 4 and NRC's rulemaking plan quoted therein.

NRC's rulemaking plan for new Part 72 licensees, regarding the option to use a graded approach to seismic design for ISFSI SSCs, states:

An individual SSC may be designed to withstand only Frequency-Category-1 events (the less stringent criteria) if the licensee's analysis provides reasonable assurance that the failure of the SSC will not cause the facility to exceed the radiological requirements of 10 CFR 72.104(a). If the licensee's analysis cannot support this conclusion, then the designated SSC must have a higher importance to safety, and the SSC must be designed such that the facility can withstand Frequency-Category-2 events without impairing the ISFSI's capability to perform safety functions and without exceeding the radiological requirements of 10 CFR 72.106(b).

SECY-98-126, Rulemaking Plan, *Geological and Seismological Characteristics For the Siting and Design of Dry Cask ISFSIs*, 10 CFR Part 72, dated June 4, 1998, at 5, ¶ 2.

The radiological requirements of 10 CFR 72.104(a) are that

During normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid and 0.25 mSv (25 mrem) to any other critical organ as a result of exposure...

The PFS Exemption Request does not make reference to the radiological requirements of 10 CFR § 72.104(a). Instead, the request cites a different set of radiological requirements summarized in a 1998 NRC staff report regarding a similar request for exemption from DOE:

For seismic events, the staff has accepted DOE's approach of designing SSCs with failure consequences within the public dose limit of 10 CFR 20.1301(a)(1), 1 mSv (100 mrem), to withstand the 1000-year return period mean ground motion. Meanwhile, SSCs with higher potential accident doses must be designed to withstand the 10,000-year return period mean ground motion.

Exemption Request at 4.

PFS argues that the canisters it will be using at the proposed ISFSI meet the radiological requirements of 10 CFR § 20.1301(a)(1), and that consequently a 1,000-year return period is appropriate for the seismic design of their proposed facility:

In its second round RAI response letter (Reference 7), PFS presented an analysis of the effects of such a beyond-design basis accident involving failure of a SSC important to safety in which a canister is postulated to leak continuously for 30 days under hypothetical accident conditions with 100% of the fuel rod cladding assumed to have failed, in accordance with the NRC's Interim Staff Guidance-5. The response to RAI 7-1 shows that the total effective dose equivalent (TEDE) from this accident to an off-site individual was calculated to be 74.9 mrem. This analysis conservatively assumed that the individual was continuously located at the PFSF owner-controlled area boundary for 30 days. The dose from this hypothetical accident condition, for which no credible mechanism has been identified, is not only well below the 0.05 Sv (5 rem) siting evaluation factor of 10 CFR 72.106(b), but also below the 100 mrem public dose limit of 10 CFR 20.1301(a)(1).

Exemption Request at 5.

It should be noted that although the calculated dose of 74.9 mrem is below the 100 mrem public dose limit of 10 CFR § 20.1301(a)(1), it is not below the 25 mrem dose limit of 10 CFR § 72.104(a) - the dose limit in NRC's rulemaking plan for which the 1,000-year return period could be used for seismic design of ISFSIs.

A more serious shortcoming of the PFS analysis is that it appears to consider the failure of only a single cask in a facility designed to store up to 4,000 casks. There is no justification for assuming that only a single cask will fail in a situation where cask failure is induced by strong ground motion from an earthquake.

Unless PFS can provide a compelling argument that the radiological

consequences of potential cask failures in an earthquake will not exceed the 25 mrem limit of 10 CFR § 72.104(a), then, based on NRC's rulemaking plan for ISFSIs, it appears that PFS should be required to use a return period of 10,000 years instead of 1,000 years to calculate their probabilistic design ground motions. Whether the 100 mrem public dose limit of 10 CFR § 20.1301(a)(1) or the 25 mrem limit of 10 CFR § 72.104(a) is ruled to apply, the scenario of multiple-cask failure surely must be addressed.

B. Incomplete documentation in Appendix F of Geomatrix (1999a) report

Documentation in Appendix F of the 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, 3 vols, is incomplete, at least in the following respects:

1. The velocity-damping models used in the Skull Valley site response evaluation are not clearly and completely described in Appendix F (Geomatrix, 1999a, pp. F-8 to F-9).

The models used appear to be combinations of (1) one of the "crustal profiles" listed in Table F-5 and (2) either the "soil profile" shown in Figure F-4 or a modified version of this profile. This point should be clarified, and the different soil profiles used should be tabulated in the same manner as the crustal profiles in Table F-5.

2. Appendix F does not include a reference list, and many of the references cited in this appendix are not in the reference list of the main report.

3. In the main body of the report on p. 8 of Vol. I, Section 1.18, the text states: "The analysis of the earthquake catalog is provided in Appendix F." Neither Appendix F nor any other appendix provides such an analysis of the earthquake catalog. Appendix F deals exclusively with attenuation relationships and ground-motion modeling.

INTERROGATORY NO. 4 - UTAH L: Identify and fully explain each and every respect in which the State claims that the Applicant's seismic analysis is insufficient to satisfy the requirements of the NRC regulations, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 4 - UTAH L:

This response is based upon information currently available and produced by the Applicant. The State's position may change, for example, if further information is produced by the Applicant.

A. The Applicant has not performed a fully deterministic seismic hazard analysis.

The Licensing Board has affirmed that, absent an exemption from the requirements of 10 C.F.R. Part 72 relating to ISFSI seismic analysis, under the current provisions of 10 C.F.R. § 72.102(f)(1), "a facility like that proposed by PFS [for Skull Valley, Utah] must meet the same standards applicable to a nuclear power plant under 10 C.F.R. Part 100, Appendix A." Memorandum and Order (Denying Motion to require Rule Waiver Request or to Amend Contention Utah L) dated May 26, 1999, at 2. The Board points out that "[t]he Part 100 standard for calculating a safe shutdown or design earthquake uses a deterministic approach." *Id.* The Board further points out

that a safe shutdown or design earthquake is defined as "'that earthquake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake which produces the maximum vibratory ground motion for which certain [subsequently defined safety] structures, systems, and components are designed to remain functional.' 10 C.F.R. Part 100, App. A, § III(c)." *Id.* at note 1 (*emphasis added*).

The Applicant has submitted two seismic analyses identified as "deterministic." The first was included in the 1997 SAR, Appendix 2D, Rev. 0. The second, Geomatrix Consultants, Inc., "*Update of Deterministic Ground Motion Assessments*," (3 pages of text plus 4 Figures), April 1999, (hereafter "Geomatrix 1999b"), was submitted by the Applicant to NRC under cover letter dated April 8, 1999, as part of PFS's Commitment Resolution #3. In both these analyses, the methodology used by Geomatrix Consultants, Inc., was not deterministic in the standard sense. Rather, it was a hybrid methodology that incorporated probabilistic elements and accompanying uncertainties in the treatment of the seismic sources and other inputs to the analyses. As a result, the maximum vibratory ground motion at the Skull Valley site has not been documented by the Applicant.

One implication, apart from the outcome of the Applicant's request for exemption to 10 C.F.R. § 72.102(f)(1), is that the results of the Applicant's

"deterministic" analyses do not provide a fully deterministic benchmark to which results of any probabilistic analysis can be compared. Nor do they provide the credible upper-bound ground motions for which certain scenarios, say cask tipover, should be considered. Because some important parts of the "deterministic" methodology used in the SAR were also used in the April 1999 update (Geomatrix 1999b), we first revisit the SAR.

1. "Deterministic" Seismic Analysis in SAR.

The State identified three issues relating to whether or not the Applicant's seismic analysis in the SAR met the requirements of 10 C.F.R. Part 100, App. A: (1) the uncertain regulatory status of the extended approach that adds probabilistic elements (beyond the use of the 84th percentile ground motions from the maximum earthquake) to the deterministic ground motion assessment; (2) the probabilistic treatment of the maximum background earthquake; and (3) the neglect of hangingwall and "near fault" effects in estimating ground motions at the PFS facility site due to rupture on the Stansbury fault.

The SAR, Appendix 2D at 32 indicates that the use of 84th percentile ground motion levels "has been established by precedent in the application of [10 C.F.R. Part 100] Appendix A." The SAR, however, describes how the methodology that was actually used departed from the standard approach:

The standard approach used to assess design ground motions from maximum events for nuclear facilities is to use the 84th percentile of the

empirical distribution of peak motions. We have extended this approach to include the uncertainty in maximum magnitude, minimum source-to-site distance, and selecting appropriate attenuation relationship in the estimation of the 84th percentile ground motion levels.

Id. at 37. For reference, the 84th percentile peak ground accelerations determined in the SAR for the PFS site, using the hybrid deterministic-probabilistic approach, were 0.67 g and 0.69 g for the horizontal and vertical directions, respectively (SAR, App. 2D, Rev. 0, p. 40).

In addressing the treatment of the background earthquake, the text states:

[W]e consider the maximum magnitude for an earthquake occurring randomly in the site vicinity on an unknown source to be uniformly distributed in the range of M 5.5 to 6.5, with a mean value of 6.0. The earthquake location is assumed to be random within a 25-km-radius circle. The resulting mean distance to the epicenter is 16.7 km.

SAR, Appendix 2D, p. 36, ¶ 2.

To meet the requirements of a deterministic analysis, the State believes it is insufficient either to (a) assume the uniform distribution of magnitudes between 5.5 and 6.5 for the maximum earthquake that a background source can produce in the Utah region or (b) adopt a probabilistic epicentral distance for the maximum background earthquake. Indeed, the more detailed geological and geophysical investigations subsequently completed by Geomatrix Consultants, Inc. (1999a) confirm that such assumptions made in the SAR were not sufficiently conservative in terms of allowing for (then unrecognized) buried seismic sources beneath or very close to the site that affect design ground motions at the high frequency end of the spectrum. *See*

Geomatrix Consultants, Inc., 1999a.

The neglect of hangingwall and "near fault" effects as part of the analysis in the SAR is now moot to the extent these effects have been accounted for in the updated "deterministic" analysis by Geomatrix, 1999b.

2. Update of "deterministic" seismic analysis (Geomatrix, 1999b).

On page 1 of the report, "Update of Deterministic Ground Motion Assessments" (Geomatrix, 1999b), the following background information is given, similar to that in the SAR, regarding departure of the adopted methodology from the standard approach:

The standard approach used for deterministic ground motion assessments for nuclear facilities is to use the 84th percentile of the empirical distribution of peak motions predicted for the maximum earthquake on each seismic source occurring at the minimum source-to-site distance. We have extended this approach to include the uncertainty in maximum magnitude, minimum source-to-site distance, and selecting appropriate attenuation relationships in the estimation of the 84th percentile ground motion levels.

Again, it is unclear whether this extended approach meets the requirements of 10 C.F.R. Part 100, Appendix A insofar as it incorporates probabilistic elements to such an extent that it diminishes the standard for establishing the maximum vibratory ground motion. If results using the Geomatrix hybrid methodology are to be viewed as satisfying the requirements of 10 C.F.R. Part 100, Appendix A, then, at a minimum, a ground motion level higher than the 84th percentile should more correctly be considered because of the chain of uncertainties incorporated in the Geomatrix

methodology. Given the Geomatrix methodology, the State believes that the 95th percentile (2 standard deviation) ground motions should be selected for design purposes in order to achieve a level of conservatism comparable to the standard deterministic approach. For reference, the 84th percentile peak ground accelerations determined for the PFS site in the updated analysis (Geomatrix, 1999b, p. 3), based on the revised characterization of seismic sources (Geomatrix, 1999a), are 0.72 g and 0.80 g for the horizontal and vertical directions, respectively.

In the updated deterministic analysis (Geomatrix, 1999b), the occurrence of a random background earthquake in the site vicinity was assessed using the same method used earlier in the SAR, which the State still considers inappropriate. In this instance, insufficient conservatism in treating the maximum background earthquake by assigning a probabilistic epicentral distance is counteracted by the revised seismic-source characterization, which includes the East and West faults very close to the site. See Geomatrix Consultants, Inc., 1999a.

B. The Applicant's assertion that an earthquake exceeding the SAR design basis "is not considered a credible event" is illogical—with potentially dangerous implications.

The Applicant interprets the results of its own deterministic seismic analysis in the SAR incorrectly in one very important context that demands attention. In the Applicant's Emergency Plan ("PFS EP"), the text states:

A seismic event exceeding the design basis warrants the Alert classification. Information on the magnitude of a seismic event is

obtained from the National Earthquake Information Center in Golden, Colorado. . . . [A]n earthquake that exceeds the design basis ground motion has the potential for degradation of the level of safety, and the Alert classification is appropriate to mobilize personnel to investigate effects of the event. This is not considered a credible event.

PFS EP, Ch. 2, Rev. 3, at 2-14, Item 4 (emphasis in original).

The design basis for the PFS site referred to above is the pair of 84th percentile ground-motion response spectra shown in Figure 4-8 of Appendix 2D of the SAR. It is not the maximum credible earthquake or the maximum credible ground shaking.

Thus, exceedance of the design basis cannot be dismissed as not credible. Also, the question of whether or not the design ground motions have been exceeded cannot be answered by merely obtaining a magnitude estimate from the National Earthquake Information Center. Strong ground motion measurements from the site itself are needed in order to make this determination. See 10 C.F.R. Part 100, Appendix A § VI (a)(3).

Given that an earthquake which exceeds the design basis can credibly occur (albeit a rare event), realistic contingency plans for an earthquake emergency alert must be made. The described emergency plan which involves waiting for magnitude information from the National Earthquake Information Center (with unspecified delay time) and then declaring an Alert "only [for] a seismic event whose magnitude exceeds the design basis ground motion" (PFS EP, Ch. 3, Rev. 3, p. 3-1; see also PFSF SAR RAI No. 2, EP-2, response [emergency plan for accidents]) is simplistic and

should not be acceptable.

Besides relying on visual observations made by personnel at the PFS site in the event of a large local earthquake, emergency planning, the State suggests, should include elements such as (1) reliable on-site digital recording of strong motion and (2) the capability, both on site and off site, to determine in near real-time the actual ground motions experienced at the site, their comparison to design levels, and whether an Alert condition exists. The physical and psychological impact of a large local earthquake on personnel on-site at the PFSF should not be underestimated—and the ability of those personnel to manage an earthquake-caused accident should not be overestimated.

INTERROGATORY NO. 5 - UTAH L: Identify and fully explain each and every respect in which the State claims that the Applicant's subsurface investigations are deficient, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 5 - UTAH L:

See response to Interrogatory No. 1 for deficiencies in the seismic reflection analysis. See response to Interrogatories Nos. 3 and 4 for deficiencies in the seismic hazard analysis. Other deficiencies in the Applicant's subsurface investigations are described below.

A. General Response.

Some of the PSF subsurface characterization work and geotechnical analyses are still ongoing, such as the Cone Penetration Testing Report conducted by ConeTec,

dated May 13, 1999. The following responses do not cover this report, or any other geotechnical investigations, calculations, analyses that are ongoing.

In addition Section 2.6 of the SAR is poorly written. Figures and tables with important design assumptions, inputs, parameters, and results have not been properly referenced; hence, it is difficult to determine their origin and whether they have been substantiated. Also, analysis methods have not been properly referenced.

B. Geotechnical Design Profile Has Not Been Adequately Defined.

Figure 2.6-5 of the SAR is inadequate for geotechnical design. Soil layer boundaries are not readily apparent and are dashed with a question mark. Also, additional profile lines, other than A - A', should be developed to understand the spatial variability of layer thickness and depths across the site.

C. Spacing and Coverage of Geotechnical Borings is Inadequate.

The potential for horizontal and vertical variability in layering and engineering properties have not been identified and accounted for in the investigation, analyses, and foundation design. The geotechnical borings at the proposed PFS facility are spaced too far apart to discover any potential horizontal variation, or lack thereof, across the site. For example, borings shown in SAR Figure 2.6-2 are on approximately 750-foot spacing center-to-center. Furthermore, because of the small number of boreholes and sampling on 5-foot depth intervals, it is not possible to determine if critical layers have been sampled, or adequately sampled, for design purposes. In

addition, there are no borings under the canister transfer building, and other site buildings (e.g., security and health physics, operations, administration, etc.) and there is only one boring located under the southeast fuel storage area.

D. Soil Profile Below Depths of 100 Feet Has Not Been Characterized.

Stone and Webster , *Document Bases for Recommended Values of Dynamic Soil Properties and Coefficient of Subgrade Reaction*, 05996.01 G(B) Calculation 01-1, page 5 (hereafter "05996.01 G(B) Calculation 01-1") indicates that only two borings were drilled to 100 feet. The two borings are inadequate to determine the geotechnical design properties below depths greater than 100 feet. The soil column and its important properties should be defined to bedrock.

E. No Uncertainty of Variability Considered in Shear Wave Velocity Profile.

The design shear wave velocity shown in SAR Figure 2.6-13 appears to have been determined from seismic refraction surveys. The SAR and supporting calculation (05996.01 G(B) Calculation 01-1) use values determined indirectly from seismic refraction surveys. Also, other elastic properties (shear, Youngs, constrained, bulk moduli, and Poisson's ratio) were estimated from the results of the seismic refraction survey. No estimates of potential bias and variability have been given. Variations in shear wave velocity, and estimates of the small strain moduli derived therefrom may significantly affect the results of strong ground motion modeling studies.

The seismic refraction test may not be able to resolve thin, but significant

layers. As stated in Geotechnical Earthquake Engineering, p. 197: "A low velocity layer underlying a higher velocity layer (i.e., a velocity reversal) will not appear as an individual segment on the travel time-distance diagram. Instead, it will cause the computed depths of the layer boundaries to be greater than the actual depths. Also, blind zones, where a subsurface layer exists but is not indicated by the travel time-distance diagram, can be caused by insufficient layer thickness or insufficient velocity contrast."

Because of the above-described issues, the State cannot assess whether or not the Applicant has developed an acceptable soil model from the subsurface investigations for dynamic modeling.

F. Depth and Nature of Bedrock Has Not Been Established.

The depth to and nature of bedrock has not been established in the SAR. The depth to bedrock should be established. This should be done with conventional coring or drilling techniques and primary and shear wave velocity should be logged to bedrock for use in dynamic soil modeling computations and for calibration of travel times for other geophysical surveys. Also, coring into bedrock should be done to establish its nature and physical properties. This information is important for ground motion modeling studies.

G. Depth to Groundwater, Hydraulic Gradient, and Seasonal Variations Has Not Been Defined.

The Applicant has not definitely established the depth to groundwater and any

seasonal variations and gradients across the site in the SAR. This is important for geotechnical, hydrogeologic, and soil dynamic modeling. Depth to groundwater should be established by permanent monitoring wells and documentation of seasonal variations.

H. The Existence or Non Existence of Confined Aquifer Condition Has Not Been Established.

The SAR at 2.6-17, par. 4 is inconclusive about whether or not confined aquifer conditions exist at PSF. The presence or non-presence of confined aquifer conditions should be established at the site. This is essential for effective stress calculations used in geotechnical investigations.

I. Potential Variations of the Preconsolidation Stress Have Not Been Considered.

Geomatrix Consultants, Inc. Calculation 05996.01G(PO5-1) p. 7: states "The maximum past pressure experienced by the uppermost silty clayey layer was about 6000 psf. It is assumed that this maximum pressure was caused by approximately of an additional [sic] 80 feet of soils above the current ground surface."

There is no evidence in the geologic record for the assumption that approximately 80 feet of overburden has been removed from the PFS site since the deposition of the Bonneville Deposits. Geotechnical studies of these sediments generally attribute apparent overconsolidation of the Bonneville clays to dessication, cementation, and aging. Because these mechanism can be quite variable from place to place, it is improper to use a single value of the preconsolidation stress to represent this

unit throughout the PFS site. Better estimates of the preconsolidation stress should be obtained, both with depth and spatially throughout the site from additional subsurface investigations.

J. Uncertainty in Estimates of Poisson's Ratio.

Stone and Webster Calculation 05996.01-G(B)-01-1, p. 17, recommends use of typical values of Poisson's ratio based on published values from textbooks and/or empirical correlations. This is a great deal of uncertainty with these estimates.

K. Dynamic Soil Properties Are Poorly Defined.

In the SAR at 2.6-28, average properties and the dynamic soil properties for the storage pad are discussed. However, in computing the average properties, only the properties of the upper 30 feet have been considered. It is well known that the soil layering effect can significantly change the dynamic stiffness and damping of a footing, such as the storage pad. In addition, the foundation parameters are highly frequency-dependent. Adequacy of the foundation parameters should be justified.

INTERROGATORY NO. 6 - UTAH L: Identify and fully explain each and every respect in which the State claims that Applicant's sampling program is inadequate to "show that soil conditions are adequate for the proposed foundation loading," and the bases therefor.

RESPONSE TO INTERROGATORY NO. 6 - UTAH L:

A. Split Spoon Sampling Procedures and Documentation of Sampling Methods.

The Applicant has used Split Spoon ("SPT") sampling to estimate the amount of dynamic settlement for the facility. See PFS Response to SAR RAI No. 1, Question 2-

8. Results of SPT sampling can be highly variable, because of several possible equipment and operator errors (Seed et al., 1985). The State has found no documentation regarding the type of hammer (e.g., safety, donut, automatic trip), and whether hammer energy ratio measurements were made for the particular drill rig. The State also cannot tell whether sampling included liners and what type of drill rod were used in the sampling program. These factor affect the results of the SPT sampling (Seed et al., 1985).

B. Type of Sampling Used in the Upper 35 feet of the Soil Profile is Inappropriate for Soil Conditions.

The Applicant has generally used the wrong type of sampling to characterize the soil profile in the upper 35 feet of the soil profile. These soils are generally fine-grained and slightly cohesive. The Applicant has used disturbed (*i.e.*, SPT) sampling, which has little value in determining key design parameters for strength and compressibility. The Applicant has admitted this as follows: "It should be noted that the upper 30-35 ft of soil at the site is slightly plastic, silty clay/clayey silt. N-values would not ordinarily be used to determine static or dynamic properties of this material. Instead, undisturbed tube samples are retrieved and the properties are determined by laboratory testing portion extracted from the tubes." Stone and Webster CAR 96-PFSF-001. The upper profile (depth less than 35 feet) should be sampled with undisturbed sampling.

Also, because of the use of the wrong sampling technique, there has been a gross undersampling of the shallow soil profile. The State has tabulated the number of

undisturbed samples obtained during the field investigation from the geotechnical boreholes. See, Table 1 below. Table 1 shows that there has been a gross undersampling of undisturbed samples when compared to the number of disturbed samples that were taken (only 9 of 177 samples, or 5 percent of the samples, were undisturbed samples). The State does not believe that nine undisturbed samples are sufficient to properly characterize a 35-foot thick zone for an approximate 150-acre site, especially considering the importance of this facility.

Table 1. Summary of Sampling Done in Upper 35 feet of Profile

Borehole Number	Number of Undisturbed Samples (Shelby Tube)	Number of Split Spoon (SPT) Samples
1	0	8
2	0	8
A-1	0	8
A-2	1	7
A-3	0	8
A-4	0	8
AR-1	0	7
AR-2	0	7
AR-3	0	7
AR-4	0	6
AR-5	0	4
AR-6	1	7
B-2	1	8
B-3	2	6
B-4	1	7
C-1	1	7
C-2	2	6
C-3	0	8
C-4	0	8
D-1	0	8
D-2	0	8
D-3	0	8

D 4	0	8
E 3	0	8
E 4	0	8
Total	9	177

In addition, of these undisturbed samples, only two samples were submitted for shear strength characterization and two samples were submitted for consolidation properties. SAR Attachment 2, Geotechnical data report. This, too, is inadequate sampling and testing for a facility of this size.

C. Type of Undisturbed Sampling Used by Applicant May Still Cause Significant Disturbance.

The Applicant has used Shelby Tube Sampling to obtain undisturbed sampling for laboratory testing. This type of sampling does not always guarantee high quality samples for laboratory testing. For example, prior to the reconstruction of I-15, in Salt Lake City, which is founded on Lake Bonneville deposits like the PFS site, extensive drilling and Shelby Tube sampling was done by various local geotechnical consulting firms for the Utah Department of Transportation. Review of the subsequent consolidation tests by the I-15 design-build geotechnical consultants (*i.e.*, Woodward-Clyde and Terracon Inc.), revealed that many of the Shelby Tube samples showed signs of sample disturbance, and thus were not useable for design purposes. Ultimately, piston sampling and/or X-raying of Shelby Tube samples was employed to determine which samples had minimal disturbance. Ladd, 1999.

Further, the Applicant has admitted that sample disturbance has occurred

resulting from the drilling and sampling program (Stone and Webster Calculation 03-1). This calculation attributes unexpectedly large values of the coefficient of secondary consolidation to effects of sample disturbance. Potential sample disturbance is an important issue, especially for properly assessing the collapse potential of slightly cemented, silty soils.

INTERROGATORY NO. 7 - UTAH L: Identify and fully explain each and every respect for the State's claim that the Applicant has inadequately addressed the potential for collapsible soils, and the bases therefor. Your answer should specifically take into account the Applicant's response to RAI No. 1, Question 2.8.

RESPONSE TO INTERROGATORY NO. 7 - UTAH L:

A. RAI No. 1, Question 2.8 is Not Applicable to Addressing the Potential of Collapsible Soils.

The calculations set forth in the Applicant's response to RAI No. 1, Question 2.8, deal with estimates of dynamic settlement caused by the Design Earthquake. The methodology presented is not applicable to collapsible soils. The triggering mechanism of collapse in silts in arid climates may be wetting, static loading, or both. Collapse does not have to be triggered by an earthquake.

Regarding the calculation of the potential dynamic settlement of the soils at the PFS site due to strong earthquake shaking, the State believes that the limited geotechnical data and samples collected at the site show that the upper soft layer is generally silty clayey and clayey silt. Once the CPT data has been interpreted and key layers identified, it may be necessary to collect adequate samples for characterization of the subsurface profile in the Bonneville sediments. These materials should be carefully

examined and presence of the clayey soils across the site should be confirmed.

B. The Applicant May Have Mistaken Collapse During Consolidation Testing as Secondary Consolidation.

The Geotechnical Laboratory Report, SAR Appendix 2A, Att. 2, states: "we were concerned that the large amount of secondary consolidation may be due to the inundation of the samples with distilled water." There is another explanation of this "large amount of secondary consolidation," which has not been investigated by the Applicant. Margins of alluvial fans, aeolian deposits (especially loess deposits) and soils derived from lacustrine or evaporative processes may have collapsible fine-grained soils. The presence of collapsible soils are well documented in Utah and many of the aforementioned soils are represented on surficial geologic maps of the PFS area.

Mitchell (1993) at p. 77 describes the characteristics of these deposits: "Large areas of the earth's surface, particularly in the midwestern and southwestern United States, parts of Asia, South America, and southern Africa, are covered by soils that are susceptible to large decreases in bulk volume when they become saturated. Such materials are termed collapsing soils. Collapse may be triggered by water alone or by saturation and loading acting together. Soils with collapsible grain structures may be residual, water deposited, or aeolian."

The approximately 3 to 5 percent strain after wetting and under constant load, as shown by some of the tests samples from the Geotechnical Laboratory Report, SAR Appendix 2A, Att. 2, is direct evidence for collapsible soils. The PFS geotechnical investigation did not investigate or analyze for these types of soils.

Also, as the consolidation data was reduced and plotted, final estimates of the coefficient of secondary (*i.e.*, C_a) consolidation for subsequent settlement calculations were taken from text book values (Calculation 05996.01 G(B) 03-1, p.14) because: "Ca for the initial loading, rises to a stress ratio approximately equal to 0.5, rather than 1, as expected." In other words, the C_a values from the laboratory test program were higher than anticipated; hence text book values were used. Thus, the Applicant's estimate of secondary settlement will be lower than what is represented by the laboratory data, regardless of whether the mechanism for the "large secondary consolidation during wetting" is collapse or creep.

INTERROGATORY NO. 8 - UTAH L: Identify and fully explain any other deficiencies, not set forth in response to Interrogatory Nos. 1-7 above, claimed by the State in the geological, geotechnical or seismic analysis of the PFS site conditions, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 8 - UTAH L:

A. Undrained Shear Strength May Have Been Overestimated Due to Consolidation During Triaxial Testing.

The Applicant substituted the procedures outlined in ASTM D-2850 (Standard Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression) for those given in ASTM D-2166 (Unconfined Compressive of Cohesive Soils) and states that the results from ASTM D-2850 should "be the same obtained if D-2166 had been used SAR, Attachment 2, Geotechnical Data Report." This is not true for partially saturated soils, due to consolidation that occurs when the confining stress is applied, as discussed by ASTM D-2850, 4.3:

If the test specimens are partially saturated or compacted specimens, where the degree of saturation is less than 100 %, consolidation may occur when the confining pressure is applied and during shear, even though drainage is not permitted.

Consolidation during testing increases the shear strength of the sample and causes an overestimation of the undrained shear strength. This may lead to unconservative results for partially saturated soils and may also lead to a potentially unsafe design.

Also, review of the Applicant's two shear tests in the Geotechnical Report, SAR, App. 2A shows that a confining stress of 1.3 ksf was used for both tests. This confining stress is higher than effective in situ stress from where the samples were taken; hence the samples were overconsolidated prior to testing. This confining stress used for testing (1.3 ksf) corresponds to a vertical stress of approximately 16 feet (see calculations below):

$$\text{moist unit weight} = \text{dry unit weight} \times (1 + \text{moisture content} / 100)$$

$$\text{for these samples, dry unit weight} = (67 + 58 \text{ pcf}) / 2 = 62.5 \text{ pcf}$$

$$\text{moisture content} = (27.4 \% + 35.6 \%) / 2 = 31.5 \text{ percent}$$

$$\text{moist unit weight} = 62.5 \text{ pcf} (1 + 0.315) = 82.2 \text{ pcf}$$

$$\text{depth corresponding to overburden of 1.3 ksf} = 1300 \text{ psf} / 82.2 \text{ pcf} = 15.8 \text{ feet.}$$

However, the samples for shear strength testing were taken from depths of 10.4 and 11.4 feet. Thus, these samples were tested in the laboratory at a higher confining stress than was present in situ; and the soils were overconsolidated during testing. Overconsolidation prior to testing increases the shear strength of the sample, and

causes an overestimation of the undrained shear strength. This may also lead to unconservative result and to a potentially unsafe design.

B. Applicant Did Not Consider Soil Anisotropy During Shear Strength Test Program and Subsequent Calculations.

An inherent anisotropy exists in soils due to the microfabric of the soil as it was deposited. Clayey soils exhibit directionally dependent undrained shear strength (Ladd, 1986). Anisotropy in shear strength for the Lake Bonneville Deposits has been well documented by geotechnical consultants in the Salt Lake Valley. For foundation calculations involving sliding (*i.e.*, sliding of the storage pads due to a seismic event), the State believes the use of the direct simple shear device will give a better estimate of the true undrained shear strength, because the direction of shear is consistent with sliding.

C. Applicant May Have Used An Improper Modulus of Subgrade Reaction for Foundation Calculations.

The geotechnical report, SAR, App. 2A, Att. A, describes the soils in the upper profile (*i.e.*, Bonneville deposits) as predominately silts, clayey silt, and silty clay. These are predominately cohesive soils. However, Stone & Webster Calculation 05996.01-G(B)-01-1, page 24, inappropriately uses equations for determining the modulus of subgrade reaction (k) for cohesionless soils. This does not seem consistent with the soil characterization of the PFS site.

D. No Consideration in Foundation Design of Potential Ground Rupture of Faulting.

Plate 1 of the Geomatrix Fault Evaluation Study and Seismic Hazards

Assessment (1999) shows several post Tertiary faults and/or shear zones near and within the boundaries of the facility. The State has found no discussion of how these features were conservatively incorporated into the geotechnical design of the foundation systems.

E. No Consideration of Potential Basin Effects in Developing Ground.

There is no discussion of potential basin effects in the report Deterministic Ground Motion Analysis conducted by Geomatrix Consultants. The geology of the site warrants consideration of the basin effect. Recent Northridge earthquake data and the ongoing USGS research indicate that a significant amplification of the motion could occur due to basin effects. Conversion of body waves to surface waves could introduce surface waves at the site that are detrimental to the stability of the casks. The effect of basin effect should be considered.

F. Applicability of Attenuation Relationships to Site with Shallow Low Velocity Layer.

Both the deep soil and rock attenuation relationships have been used and the results are enveloped. Deterministic Ground Motion Analysis, Geomatrix Consultants. However, geophysical data from the site show that the site is covered with a low velocity layer (about 750 ft/sec, less than 30 ft) over laying a much stiffer layer (velocity of 2100 ft/sec). None of the attenuation relationships used is directly applicable to such a site. Recent earthquake data has shown that a significant amplification of motion takes place due to the presence of shallow soil deposits. Applicability of the attenuation relationships to this site should be demonstrated.

G. Uncertainty Exists in the P-wave Velocity Measurements.

Geomatrix calculation No. 05996.01-G(P05)-1; 3/31/97, Development of Soil and Foundation Parameters in Support of Dynamic SSI Analysis, page 2A suggests that P-wave velocity of 4000 ft/sec is applicable to the site. The reason for the erroneous measurement of 2500 ft/sec should be described and the impact of the cause on the velocity of the other layers should be explored.

H. Unknown Influence of the Sharp Contrast in Dynamic Soil Properties on Foundation Parameters and Soil Structure Interaction Analysis.

Geomatrix calculation No. 05996.01-G(P05)-1; 3/31/97, Development of Soil and Foundation Parameters in Support of Dynamic SSI Analysis, page 2B, presents and idealized dynamic model for the PFS site. The idealized model ignores the sharp contrast in the dynamic soil properties at the site and the frequency dependency of the foundation parameters for the storage pads. The adequacy of the recommended foundation parameters in light of the SSI frequency of the system should be established.

I. No Variation of Soil Parameters Has Been Considered in Performing Site Response Analysis.

Geomatrix calculation No. 05996.01-G(P05)-1; 3/31/97, Development of Soil and Foundation Parameters in Support of Dynamic SSI Analysis, page 6 considers no variation of soil parameters. Limited geotechnical test data has caused estimation of many soil properties for dynamic analysis. Lack of sufficient data warrants more consideration of potential variability of soil parameters in design application.

No variation of soil density or shear wave velocity is considered. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, NUREG 0800, Standard Review Plan ("SRP") 3.7.1, Seismic Design Parameters (Rev. 2) requires variation of Gmax by a factor of two where adequate data have not been collected. Also, since depth to bedrock is estimated with a wide range, the effect of such variation on the site response should be investigated.

J. Proper Control Point for Input About the Rock Motion Used in the Site Response Analysis.

A rock motion similar to DE has been used in the site response analysis (Geomatrix calculation No. 05996.01-G(P05)-1; 3/31/97, Development of Soil and Foundation Parameters in Support of Dynamic SSI Analysis). However, it is not clear why the DE has not been used consistent with the definition of DE in the free-field. If the DE is the motion of the ground at ground surface, the same assumption should be considered in the site response analysis. If it is an outcrop motion, the same DE motion should be used in the site response analysis.

This calculation does not appear to be in compliance with the recommendation in SRP 3.7.1, Seismic System Analysis (Rev. 2), and ASCE 4-98. NRC SRP 3.7.1 states: "For profiles consisting of one or more thin soil layers overlaying competent material ... the control point is specified on an outcrop or hypothetical outcrop at a location on the top of the competent material." It appears the Applicant has not followed the design recommendations in SRP 3.7.1.

K. Generation of Acceleration Compatible Time Histories for Design

The seed time history used to generate each component of the design time history has not been described. See 3-D Seismic Time Histories for Private Storage Facility by Holtec International, Holtec Calculation No. HI-961556, 11/8/96, page 3 and Development of PFSF Artificial Time Histories Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98.

Also, acceleration-compatible time histories are shown to match the design response spectra at only 5% damping. Other damping values may be applicable for design and analysis of the casks. To generate acceleration time histories, it is common practice to show spectrum matching requirements are satisfied at all applicable damping values (i.e., damping values applicable to the pad).

L. Use of Differing Time Histories for Seismic Design by Various Consultants.

The seed time history used to generate each component of the design time history has not been described. Development of PFSF Artificial Time Histories, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98). The seed time history used to generate each component of the design time history needs to be fully described, including its basis.

It is our general observation that different time histories have been used to represent the strong ground motion for the seismic design of the various facilities by the various PSF consultants (e.g., Stone and Webster, Holtec, etc.). A consistent set of time histories should be applied to all facilities by the various consultants conducting seismic design on behalf of the Applicant.

M. Generation of Compatible Target Power Spectrum Density Function (PSDF).

NRC SRP 3.7.1 requires generation of compatible target power spectrum density function. The Applicant's calculation, 3-D Seismic Time Histories for Private Storage Facility by Holtec International, Holtec Calculation No. HI-961556, 11/8/96, page 4, and Development of PFSF Artificial Time Histories Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98, do not describe how the compatible target PSDF was computed, or how the PSDF was obtained for each time history. The equations used to obtain PSDF should be clearly stated to ensure consistency with the target PSDF. The matching requirements for PSDF should cover frequencies from 0.3 Hz to 24 Hz based on SRP 3.7.1. Units used in the plots of PSDF should also be shown.

N. Checks for Drift in Design Time History.

There is no discussion of velocity and acceleration time histories in 3-D Seismic Time Histories for Private Storage Facility by Holtec International, Holtec Calculation No. HI-961556, 11/8/96, page 4 and Development of PFSF Artificial Time Histories Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98. For each component of the acceleration time history, the corresponding velocity and displacement time histories should be obtained to ensure there is no drift in the motion.

O. No Consideration of Fling in Developing Design Ground Motion.

Recent near-fault recordings of the ground motion from Kobe, Japan and

Northridge, California earthquakes show significant "fling" in the time histories. Such strong velocity pulses are currently maintained in design of near-fault facilities. The Applicant has not taken any measures to ensure that the "fling" due to proximity of the faults at the PSF site have been maintained in the time histories used for seismic design of the foundations.

P. Soil Structure Interaction Issues in Modeling Cask Seismic Response.

The following response pertains only to the following report: *Multi-cask Seismic Response at the PFS ISFSI for Private Fuel Storage L.L.C., Holtec Report No.: HI-97163, 5/19/97* (hereafter "Holtec Calculation").

The Holtec report presents the results of nonlinear dynamic analysis of multi-cask foundation system and simulates the sliding motion of the casks on top of the pad. It concludes that while the casks move on the pad during seismic excitation, no cask-to-cask impact would occur and the foundation is stable. The Holtec calculation is based on the simplified and inadequate assumption, which invalidates the conclusions reached for dynamic loading. The major shortcoming in the Holtec calculations are:

(1) Input Motion.

The input motion used for dynamic analysis is a direct input to the foundation model. Geophysical data at the site shows an upper soft layer of 30 ft over a competent soil layer. NRC SRP 3.7.1 requires that when a thin soft soil layer is present at the site, the input motion should be specified at the top of the competent

soil layer. The use of input motion in this calculation is inconsistent with NRC SRP 3.7.1 requirement.

Due to proximity of a major active fault, it is likely that the impinging seismic waves approach the foundation in an angle. Such motion will result in an unbalanced rocking motion, threatening the stability of the casks. The calculation should consider the effect of inclined and surface wave on the stability of the casks.

The Holtec calculation is based on nonlinear formulation of the system. Nonlinear analysis is sensitive to the phasing of the input motion. The calculation should consider use of multiple time histories with real phasing appropriate for the site to ensure that the conclusion will not change if the phasing in the input motion has changes.

(2) Foundation Modeling.

The soil springs used to represent the soil-foundation system is a set of constant soil springs. In a layered system, the foundation springs are highly frequency dependent. The spring rates used do not properly represent dynamic stiffness of the foundation system. Moreover, the spring constants used are in contrast with the values recommended in the Geomatrix Calculation (Development of Soil and Foundation Parameters in Support of Dynamic Soil-Structure Interaction Analysis). No explanation has been given for this discrepancy.

Also, NRC SRP 3.7.2 requires variation of soil properties. For sites that are under investigated such as the PFS site, SRP 3.7.2 requires variation of shear modulus

by a factor of 2. The Holtec calculation is based on only one set of spring constants and therefore does not comply with the SRP 3.7.2 requirement for adequate representation of soil properties.

The Holtec calculation assumes the mat of 30 x 60 ft is rigid under all modes of vibration. Validity of this assumption, particularly at high frequencies that are important for the cask system, should be demonstrated.

(3) Sliding Assumptions Used in Design of the Pads.

The Holtec calculation assumes a range in the coefficient of sliding. Over time cold bonding may occur and a full contact between the cask and the pad may occur. No consideration has been given to this condition.

Under smaller earthquake loading such as those events less than the design earthquake, the casks may not necessarily slide on the pad resulting in larger seismic loads acting on the foundation. This condition should be included in the calculation.

Finally, the Holtec calculation relies on the sliding motion of the casks during seismic loading to reduce foundation loads and attempts to show that no unstable condition including cask-to-cask impact would occur. Such computation, even under idealized condition, is highly questionable because there are a significant number of parameters involved in the calculation whose variation could readily change the conclusion. Therefore, the State considers the design presented in this calculation a gross under design in the PFS facility, which could cause a significant number of casks to become unstable under the design motion.

Q. Uncertainty Regarding Dynamic Loading Used to Assess the Foundation Stability of the Pad.

On page 37 of the report, "Storage Pad Analysis and Design", Civil Engineering Consultants, 6/17/97, it is not clear what dynamic loading has been considered for foundation stability and design of the pad. The conditions and the assumption used to develop the maximum dynamic load acting on the pad should be clearly stated. Also, it is not clear why a friction value larger than 0.8 (due to potential cold bonding) was not considered.

R. Variation of Soil Properties Not Considered in Analyzing Foundation Loadings for Pads.

Page 29 of the report, "Storage Pad Analysis and Design", Civil Engineering Consultants, 6/17/97 does not consider variation of soil properties as required in NRC SRP 3.7.2.

S. Conclusions Regarding Vertical Pressure and Allowable Vertical Capacity Not Given.

Page 178 of the report, "Storage Pad Analysis and Design," Civil Engineering Consultants, 6/17/97 does not give any conclusions regarding the vertical soil pressure, nor is it possible to determine whether the vertical pressure is less than the capacity. The allowable capacity should be presented and conclusions clearly stated.

T. Use of Active Soil Pressure May Not Be Appropriate for Seismic Case.

Page 179 of the report, "Storage Pad Analysis and Design," Civil Engineering Consultants, 6/17/97 uses the at rest soil pressure for static load; however, the seismic soil pressure is based on the active soil pressure. These two assumptions are

inconsistent. In a recent position paper, NRC allows use of active seismic soil pressure only if it can be shown that adequate movement occurs to justify reduction of the soil pressure. The seismic soil pressure is expected to be larger than the minimum active pressure used in the calculation.

U. Inertia Load of the Foundation Pad Should Be Rigorously Computed.

For inertia of the pad, only PGA has been used. See, Storage Pad Analysis and Design, Civil Engineering Consultants, 6/17/97. The pad is resting on a soft soil layer. The SSI frequency of soil-pad system is expected to be at a much lower frequency. This would increase the inertia load of the foundation pad. The inertia load of the foundation pad should be rigorously computed. Use of PGA underestimates the inertia load.

V. Soil-Foundation Separation Has Not Been Considered.

Both ASCE 4-98 and SRP 3.7.2 require consideration of soil foundation separation in the design. This requirement has not been met in the design of the pads. See, Storage Pad Analysis and Design, Civil Engineering Consultants, 6/17/97).

W. Basis for Use of Full Passive Pressure Not Documented.

It is a reasonable and common practice in geotechnical engineering to ignore the passive pressure in the upper 3 to 5 ft of soil due to small confinement effect and disturbance, separation during excitation, etc. The basis for using the full passive pressure for the entire depth of embedment should be clearly stated. See, Storage Pad Analysis and Design, Civil Engineering Consultants, 6/17/97.

X. Use of Full Undrained Shear Strength Overstates Sliding Factor of Safety of the Pad.

Based on only two test data for a 150-acre site, a shear strength value of 2.2 ksf had been selected and used in stability analysis of the pad (see, "Storage Pad Analysis and Design," Civil Engineering Consultants, 6/17/97). No variation of this parameter has been considered. Moreover, instead of adhesion, the shear strength itself has been used for design. Naval Facilities Design Manual, 7.2 (NAVFAC, 1982) provides an adhesion of 950 to 1300 psf for clays with shear strength of 2000 to 4000 psf. The basis for using 2.2 ksf in design should be clearly stated.

In general, the State believes calculations provided for the stability of the pads grossly under estimates the load and over estimates the capacity. For a surface foundation supporting such a large load and under the severe seismic shaking postulated in the design motion, sliding of the pad is a major design issue.

Y. No Development of Compatible Target Power Spectrum Density Function (PSDF).

NRC SRP 3.7.1 requires generation of compatible target power spectrum density function. The Applicant's calculation, Development of PFSE Artificial Time Histories, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98, does not develop a compatible target power spectrum density function. The calculation is not in compliance with NRC SRP 3.7.1.

Z. Checks for Drift in Design Time History.

There are no plots of velocity and displacement time histories. Development of

PFSF Artificial Time Histories, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-3, 6/17/98. For each component of the acceleration time history the corresponding velocity and displacement time histories should be obtained to ensure there is no drift in the motion.

AA. Issues Regarding Procedures Used to Develop Strain-Compatible Soil Properties.

It is not clear in Development of Soil Impedance Functions for Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-4, 6/15/98 whether the time histories used in calculating the strain-compatible soil properties are the same as those used in the dynamic analysis of the building. It cannot be determined whether bedrock was modeled in the soil profile. A layered soil system, like the PFS site, limits the amount of radiation damping, which otherwise would be overestimated if a deep soil profile was assumed.

AB. Greater Variation of G_{max} Required by SRP 3.7.2 in Performing Site Response Analysis.

The maximum soil shear modulus has been varied from $1.5 \cdot G_{max}$ to $0.67 \cdot G_{max}$ Development of Soil Impedance Functions for Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-4, 6/15/98. Such limited variation of G_{max} is allowed by the SRP 3.7.2 and ASCE 4-98 only if it can be shown that the above range adequately covers the scatter of the measured soil properties. For cases where limited soil data are available (such as the case for PFS site), both ASCE and SRP 3.7.2 require variation of G_{max} by

a factor of two. Since no statistical variation of soil properties has been presented, the range of soil properties considered does not comply with the ASCE and SRP 3.7.2 requirements.

AC. Assumptions Regarding Rigidity of Mat for Canister Transfer Building.

The foundation mat with dimensions of 265 x 165 ft is considered to be rigid.

Development of Soil Impedance Functions for Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-4, 6/15/98. This is not a reasonable assumption for such a large mat. ASCE 4-98 requires consideration of mat flexibility in the dynamic analysis. The basis for the above assumption should be clearly stated. Vibration of such a large flexible mat would result in amplification of the motion in the structure as well as the stresses in the mat.

AD. Documentation of Units and Relationships.

The units for the stiffness and damping coefficients are not presented.

Development of Soil Impedance Functions for Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-4, 6/15/98. The Applicant must provide the relationship between the force and displacement (also moment and rotation) for the mat so the nature of the stiffness and damping coefficients depicted in the figures included in the calculation can be examined.

AE. Documentation of Dimensions of Structural Members Used in Analyses.

On page 4 of Seismic Analysis of Canister Transfer Building, Stone and

Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, it is stated that since no information on thickness of the walls, slabs and beams are available, they were assumed for the purpose of analysis. The Applicant must either revise its calculations to consider the final member sizes in the dynamic response of the building, once such data are available, or describe some other approach that will justify the assumptions used in the analysis

AF. Proper Location of Control Point for the Rock Motion Used in the Site Response Analysis.

Direct use of the design time histories in the lumped mass model implies that the design motion has been specified at the ground surface level. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98. This assumption is not in compliance with NRC SRP 3.7.2 which requires input of the control motion at the top of the competent soil layer for sites where a soft soil layer is present at the surface.

AG. Issues Regarding Selection of Cut-Off Frequency.

A cut-off frequency of 15 Hz is used in the analysis and a parametric study is performed up to 20 Hz to justify the cut-off frequency. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4. The justification given is inadequate. The modal frequencies of the building and the modal mass should be computed. Based on the modal properties it can be concluded whether the cut-off frequency of 15 Hz is adequate or not. Also, there may be local modes present in the structure that may

influence the responses locally. If such modes correspond to modal frequencies above 15 Hz, the analysis would not capture the amplification caused by such modes.

AH. Basis for Ignoring Translation Motion Cause by the Rotation.

The basis for ignoring the translational motion caused by the rotation is not stated in Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4. The basis for this assumption should be clearly discussed.

AI. Consideration of Concrete Cracking.

ASCE 4-98 requires consideration to the effect of concrete cracking. The calculation Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4 should state what measures, if any, has been taken to include concrete cracking.

AJ. Consideration of Accidental Torsion.

ASCE 4-98 requires consideration of accidental torsion in seismic loads. Measures taken, if any, should be discussed and considered that include accidental eccentricity in the seismic loads. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4.

AK. Combination of Coupling Effects.

The calculation Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4, should discuss how the coupling effects for seismic loads and for in-structure responses

are combined.

AL. Percentage of Live Load Used in Calculation of Lumped Mass Values.

The calculation Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 4 should discuss the percentage of live load considered in the calculation of the lumped mass values.

AM. Amount of Peak Broadening Considered.

The calculation Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 5, should discuss the amount of peak broadening considered in the developing in-structure responses.

AN. Center of Rigidity.

The center of rigidity and the center of mass in the stick model should be clearly identified in a table or in a figure depicting the model in all 3 directions.

Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 8. It is not clear whether this model is a concentric model or not, and whether the centers of rigidity in shear and bending are the same as those for axial loading.

The center of rigidity of the stick model at the basemat level in shear and axial may not coincide with the location of soil springs. The Applicant should discuss the extent of eccentricity between the location of the foundation springs and the center of

rigidity of the stick model.

AO. Consideration of Both Translation and Rotational Mass Properties.

It is unclear what translational and rotational mass properties of the mat were considered in the analysis and at what location and elevation the lumped properties were placed in the SSI model. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 8.

AP. Soil Structure Interaction (SSI) Effects on Building Response.

The SSI effect on the response of the building should be discussed and how the SSI frequencies compare with the fixed based frequencies. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 8.

AQ. Modeling of Secondary Systems in Dynamic Analysis.

ASCE 4-98 requires consideration of equipment structure interaction depending on the dynamic properties of the secondary and primary systems. The Applicant should discuss what secondary systems and components are present in the Canister Transfer Building and how these systems are modeled in the dynamic analysis. Seismic Analysis of Canister Transfer Building, Stone and Webster Engineering Corporation, Calculation No. 05996.02-SC-5, 7/9/98, p. 8.

AR. Load Combinations for Bearing Capacity Calculations For Transfer Building.

The load combination given in Allowable Bearing Capacity of the Canister Transfer Building Supported on a Mat Foundation, Stone and Webster Calculation

05996.02, G(C), 13 p. 6, does not mention the live load. It is unclear what live load has been used.

The full shear strength of the upper layer is used instead of adhesion in the sliding stability analysis. Sliding of a surface structure at such a high level of seismic load is expected to be a major concern.

AS. Use of Full Undrained Shear Strength Overstates Sliding Factor of Safety of the Mat Foundation of the Canister Transfer Building.

Similar to the design of the cask pads, the full shear strength of the upper soil layer is used instead of adhesion to analyze the undrained sliding stability of the transfer building foundation. Allowable Bearing Capacity of the Canister Transfer Building Supported on a Mat Foundation, Stone and Webster Calculation 05996.02, G(C), 13. Potential sliding of the foundation at the soil-bottom of the mat interface due to the imposed seismic loads is a major concern.

C. Document Requests – Utah L

During the February 1999 informal interview of seismic experts for both sides, the State and PFS discussed various publications, reports and other documents prepared by their experts and generally agreed on the scope and relevance of those documents to this proceeding. Part of the mission of one State agency, Utah Geologic Survey, is to publish reports relevant to Utah's geology. Furthermore, the breadth of publications of some of the State's experts makes it unreasonable and burdensome for the State to produce documents for which the State does not intend to rely in developing and presenting its case or for which the Applicant has not made a specific

request. All publications by the State agency and its experts are either publically available or readily available to PFS's seismic experts. Notwithstanding the foregoing, the State is willing to re-visit the relevance of various documents and arrive at a mutually acceptable arrangement with PFS without resort to unnecessarily copying publications and reports that are not relevant to Utah Contention L.

DOCUMENT REQUEST NO. 1 - UTAH L: All documents related to the claims raised by the State, as admitted by the Board, in Contention L.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH L:

Except as noted in responses below, the State has produced all non-privileged documents to PFS with respect to Contention L.

DOCUMENT REQUEST NO. 2 - UTAH L: All documents, data or other information generated, reviewed, considered or relied upon by the Utah Geological Survey, Walter Arabasz, James Pechmann, or any other expert or consultant assisting the State, in connection with respect to Utah Contention L.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH L:

The State objects to this document request to the extent that it requests production of privileged material. In addition to the non-privileged documents already produced, the State's experts have reviewed and considered such information as the license application, RAI responses and various reports prepared on behalf of the Applicant (including references therein), PFS's seismic exemption request, documents relevant to Contention L obtained through discovery from PFS's files, and appropriate NRC regulations and guidance documents. *See also* response to Document Request No. 4, below.

DOCUMENT REQUEST NO. 3 - UTAH L: All documents prepared by the Utah Geological Survey, Walter Arabasz, James Pechmann, or any other expert or consultant assisting the state with respect to Utah Contention L, reviewing, analyzing, evaluating or otherwise relating to PFS's application and the geological, geotechnical and seismic studies and analysis done on behalf of PFS.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH L:

The State objects to this request to the extent that it call for production of privileged information. Notwithstanding this objection, the State has already produced all non-privileged documents relevant to this request. Furthermore, substantial information relevant to the review and evaluation by the State's experts and consultants of PFS's application and supporting studies is included in this overall response to PFS's Formal Discovery Request as well as in the State's April 30, 1999 Motion Requiring Applicant to Apply for Rule Waiver Under 10 CFR § 2.758(b) or in the Alternative Amendment to Utah Contention L.

Additionally, the Index Map (entitled *Commercially Available Seismic Reflection Lines, Skull Valley, Utah*, June 1999) referred to response to Interrogatory No. 1 is available for inspection and copying at the office of Ms. Connie Nakahara, Utah Department of Environmental Quality.

DOCUMENT REQUEST NO. 4 - UTAH L: All documents, data or other information describing, reviewing, analyzing, evaluating or otherwise relating the physical properties of the soils in the vicinity of the PFS facility, including any documents related to the presence or absence of collapsible soils, cemented soils or soils subject to liquefaction.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH L:

The State objects to this request to the extent that it calls for production of

privileged information. Notwithstanding this objection, the State has already produced all non-privileged documents relevant to this request. In addition, the following publications and reports relate to the State's evaluation of soils at the PFS site.

1. Kramer, Steven L., Geotechnical Earthquake Engineering, Prentice-Hall, Upper Saddle River, New Jersey.
2. Ladd, C. C., 1999 "Parameter Development for Estimating Settlements Due to Primary Consolidation and Secondary Compression," 34th Annual Symposium on Engineering Geology and Geotechnical Engineering, Utah State University, Logan, UT, April 28-30, 1999.
3. Ladd, C. C., 1986. "Stability Evaluation During Staged Construction," The Twenty-Second Terzaghi Lecture, Journal of Geotechnical Engineering, Vol. 117, No. 4, April, 1991.
4. Mitchell, J. K., 1993. Fundamentals of Soil Behavior, John Wiley and Sons, Inc., 1993.
5. Seed, H. B., Tokimatsu, K., Harder, L. F., and Chung, R. M. 1984. "Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations," Journal of Geotechnical Engineering, Vol. 111, No. 12, Dec. 1985.
6. Stone and Webster Corrective Action Report (CAR) (96-PFSF-001), Dated Nov. 1, 1996.

The above described publications and reports are readily available to the Applicant and will not be produced by the State.

DOCUMENT REQUEST NO. 5 - UTAH L: All documents describing, reviewing, analyzing, evaluating or otherwise relating to geological or geotechnical conditions of the PFS site or to geological or geotechnical conditions which the State claims may impact the PFS ISFSI.

RESPONSE TO DOCUMENT REQUEST NO. 5 - UTAH L:

Available for inspection and copying at Ms. Connie Nakahara's office of the

Utah Department of Environmental Quality is a memo dated March 28, 1997 from Robert L. Morgan (State Engineer) to Dam Safety Staff, Regional Engineers relating to Division Policy for random earthquake events for design and evaluation of dams.

DOCUMENT REQUEST NO. 6 - UTAH L: All documents relating to the methodologies and standards required by the Utah Geological Survey or any other Utah agency, including the Utah Department of Transportation, for conducting probabilistic seismic hazard analysis.

RESPONSE TO DOCUMENT REQUEST NO. 6 - UTAH L:

The State objects to this request as over broad. To the State's awareness, the only Utah agency which has promulgated any guidelines for seismic hazard analysis is the Utah Division of Water Rights, Dam Safety Section. A summary of the rules (Utah Administrative Rules R655-10 through -12) currently in effect as of July 1996, can be obtained from the World Wide Web at the following URL:

<<http://nrwrt1.nr.state.ut.us/daminfo/rules.html>>.

DOCUMENT REQUEST NO. 7 - UTAH L: All documents, including any studies or reports, employing a probabilistic seismic hazard approach performed by the Utah Geological Survey or any other Utah State agency, or prepared for the Utah Geological Survey or any other Utah State agency.

RESPONSE TO DOCUMENT REQUEST NO. 7 - UTAH L:

The State objects to this request as over broad. Notwithstanding this objection, the State has available for inspection and copying in Ms. Nakahara's office the following:

1. Utah Department of Transportation, I-15 Corridor Reconstruction Project, Request For Proposal, Project No. SP-15-7(135)396 (October 1, 1996), Section 8.12, Dames & Moore, Final Report Seismic Hazard Analysis of the I-15 Corridor 10600 South to 500 North, Slat Lake County, Utah (September 6, 1996).

2. Woodward-Clyde Consultants, August 1994, *Final Report - Seismic hazard evaluation, Kennecott tailings impoundment modernization project, Magna, Utah*, prepared for Kennecott Utah Copper Corporation.

DOCUMENT REQUEST NO. 8 - UTAH L: All documents, including any studies or reports, related to probabilistic seismic hazard assessments performed, reviewed or evaluated by Walter Arabasz, James Pechmann or any other expert or consultant assisting the State with respect to Utah Contention L.

RESPONSE TO DOCUMENT REQUEST NO. 8 - UTAH L:

The State objects to this request as over broad, burdensome, and irrelevant.

Drs. Arabasz and Pechmann have spent significant parts of their academic careers in the area of probabilistic seismic hazard analysis. To request all studies or reports in this area that either of these academics have ever performed, reviewed, or evaluated is unreasonable. See e.g., lists of publications and professional consulting in the curriculum vitae for Dr. Arabasz and Dr. Pechmann. Notwithstanding these objections, the State is willing to work with PFS to determine whether any of the multitude of boxes of personal files that these academic experts have, and which are unrelated to their work in assisting the State with respect to Contention L, may be subject to production.

The performance of a probabilistic seismic hazard analysis [PSHA] is well known to require multidisciplinary participants as well as elaborate computer codes. Separate from their involvement in PSHAs conducted by others, Dr. Pechmann and Dr. Arabasz have performed three rudimentary PSHAs. These are summarized and described in the following publications:

Arabasz, W. J., Pechmann, J. C., and Brown, E. D., 1987, Evaluation of

seismicity relevant to the proposed siting of a Superconducting Supercollider (SSC) in Tooele County, Utah, Technical Report to the Dames & Moore Utah SSC Proposal Team, Salt Lake City, Utah, 107 p. (Reprinted as Utah Geological and Mineral Survey Miscellaneous Publication 89-1, January 1989). See State produced document UT-22008-22118.

Arabasz, W. J., Pechmann, J. C., and Brown, E. D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch front area, Utah, *in* Gori, P.L., and Hays, W. W., eds., Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500-A-J, p. D1-D36.

Pechmann, J.C., and Arabasz, W.J., 1995, The problem of the random earthquake in seismic hazard analysis: Wasatch Front region, Utah, *in* Lund, W.R., ed., Environmental and engineering geology of the Wasatch Front region: Utah Geological Association Publication 24, p. 77-93.

DOCUMENT REQUEST NO. 9 - UTAH L: All documents relating to the proper methodologies and standards, as claimed by the State and its experts and consultants, for conducting probabilistic seismic hazard analysis.

RESPONSE TO DOCUMENT REQUEST NO. 9 - UTAH L:

The State objects to this request to the extent that it call for a legal opinion.

Furthermore, 10 CFR Part 72 and Part 100 require PFS to conduct a deterministic seismic hazard analysis. The appropriate methodologies and standards for conducting such an analysis are contained in 10 CFR § 72.102(b), 10 CFR § 100.23, and 10 CFR Part 100, Appendix A. Guidance for performing a probabilistic seismic hazard analysis is given in Reg. Guide 1.165 "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion" (March 1997).

The State will supplement its response to this request if and when PFS is granted an exemption to 10 CFR § 72.103(f)(1) that would allow it to conduct a

probabilistic seismic hazard analysis at the site.

VI. BOARD CONTENTION 11 (UTAH O) HYDROLOGY

A. Requests for Admission – Utah O

REQUEST FOR ADMISSION NO. 1 - UTAH O: Do you admit that PFS's water usage during construction would have no measurable or adverse impact on other well users and on the aquifer? (EIS RAI 8-1, 9-4)

RESPONSE TO ADMISSION REQUEST NO 1 - UTAH O:

Utah objects to answering this Request and Interrogatory No. 7 on the grounds that the Utah State Engineer has independent adjudicative authority and has not taken action on any water right application from PFS. If and when any action is taken, the Utah State Engineer will exercise his statutory responsibilities in determining whether to approve or deny any application in conformance with law and the available data. The following response is provided, subject to this objection, and the fact that the State Engineer cannot be bound by the responses herein in his adjudicative proceedings.

Notwithstanding the foregoing objections, the State admits in part and denies in part, Request for Admission No. 1. PFS estimates that the water usage during construction will be 8,500 gallons per day or about 5.9 gallons per minute. Admit that a well producing this quantity of water is considered small and most likely will not result in significant stresses on the aquifer system. As discussed below, PFS has conducted an inadequate investigation to determine whether no measurable or adverse impacts will occur.

Deny that PFS's water usage during construction would have no measurable or adverse impact on other well users. First, PFS has not identified the specific location of the production well (or wells). Therefore, PFS cannot make a finding that no measurable or adverse impacts will occur to other wells. Second, in Response to EIS RAI 8-1, PFS adapted the Jacob formula to estimate the impact of its water use on the aquifer. In selecting the Jacob formula to estimate the potential cone of influence of the production well, PFS has not stated whether the assumptions upon which the Jacob formula is based fit the conditions at the site. Without a thorough evaluation of these assumptions, PFS's claim that there will be no measurable or adverse impact on the aquifer is questionable.

REQUEST FOR ADMISSION NO. 2 - UTAH O: Do you admit that PFS's water usage during operations would have no measurable or adverse impact on other well users and on the aquifer? (EIS RAI 8-1, 9-4)

RESPONSE TO ADMISSION REQUEST NO. 2 - UTAH O:

The objections raised in Response to Admission Request No. 1 are fully incorporated herein. Notwithstanding the objections raised in the above response No. 1, the State admits in part and denies in part, Request for Admission No. 2. See Response to Request for Admission No. 1. The estimated quantity of water needed for operational purposes is about 3850 gallons per day or about 2.7 gallons per minute. The same concerns as set forth in Admission Request No 1 above also apply to this response.

REQUEST FOR ADMISSION NO. 3 - UTAH O: Do you admit that the depth to groundwater beneath the PFSF site is at least 100 ft.? (EIS RAI 8-1)

RESPONSE TO ADMISSION REQUEST NO. 3 - UTAH O:

Admit in part and deny in part. Admit that PFS has drilled one two inch diameter well somewhere on the site that measured groundwater at 100 feet or more below ground surface. Deny that PFS has established the depth to groundwater because it has not established any permanent monitoring wells, has not documented any seasonal variations in groundwater depth, and has not determined any gradients across the site.

REQUEST FOR ADMISSION NO. 4 - UTAH O: Do you admit that construction, operation, and maintenance of the PFSF would have no measurable or adverse impact due to groundwater contamination on hydrological resources downgradient from the facility?

RESPONSE TO ADMISSION REQUEST NO. 4 - UTAH O:

Denied. PFS has not demonstrated through its site investigations and submittals that there will be no measurable or adverse impacts due to ground water contamination. The site comprises a large area of approximately 99 acres for storage of high level nuclear waste. The operation includes heavy equipment/maintenance, laboratory chemicals, small quantities of hazardous wastes, petroleum product storage and use, sanitary waste disposal, sumps and other potential pollutants including the high level nuclear waste. For example, there are operating procedures to detect contaminated casks or canisters. The SAR acknowledges that potential contamination can occur if proper procedures are not followed. SAR at 6.4-1 and 2. But the SAR does not properly anticipate problems when standard practices are not followed, errors are made or accidents occur. The fact that site ground water monitoring is not planned

means PFS would not know whether all their assumptions on protecting ground water are correct or whether errors and accidents have caused a problem. This would allow contamination to escape to ground water, and without monitoring, problems may not be detected, thereby allowing significant degradation of hydrologic resources. Ground water monitoring is a prudent method to verify that there are no impacts to groundwater and to allow detection and early correction of problems.

Experience dictates that there are degradation impacts on ground water from many surface activities. PFS has not made efforts to isolate stormwater from ground water with appropriate liners which further provides the possibility of contamination. Furthermore, the PFS submittal has not properly characterized the ground water under the site. The Applicant has not performed sufficient work at the site to determine direction of flow and the chemistry of the ground water. Such work is necessary to allow proper detection of contaminants from the site. The ITF and transportation to the proposed ISFSI site also presents the opportunity for ground water or surface water contamination.

B. Interrogatories - Utah O

INTERROGATORY NO. 1 - UTAH O: Identify each of the specific pathways from PFS's sewer/wastewater system, the "retention pond" (hereinafter "detention basin"), ISFSI operations, and ISFSI construction activities through which the State contends that surface water and groundwater in Skull Valley could become contaminated, and the technical and scientific bases therefor.

RESPONSE TO INTERROGATORY NO. 1 - UTAH O:

1. Sewer/wastewater system. The wastewater system consists of a subsurface

drainfield which disposes liquids and pollutants into the ground and eventually the ground water. PFS has not provided feasibility information or sizing information to show that soil and ground water conditions are suitable for a drainfield. If installation occurs in unsuitable soils, less soil treatment is provided for sanitary wastes. Another means of contamination is the disposal of improper materials in the drainfield such as laboratory chemicals, floor drains, solvents, petroleum products, radiologics etc. If sump water is discharged to the drain field following testing, errors or negligence could occur allowing releases to ground water via the drainfield.

2. Retention Pond. The retention pond is unlined and unmonitored, allowing its contents to discharge to ground water. Rainwater falling on the nuclear waste storage areas and all other areas of the operation can be contaminated with spills, leaks, accidents, poor house keeping, and other inappropriate activities. These materials would be carried by stormwater into the ground water along with any pollutants they carry. The unlined and unmonitored retention pond provides a pathway to pollute ground water.

3. ISFSI Operations. The discussion in items 1 and 2 above also applies to the ISFSI operations. In addition, these operations allow rainwater to come into contact with storage containers, which, if leakage occurred or external container contamination exists, could wash off and infiltrate into the groundwater. No containment is provided for rain water on site and no monitoring of groundwater is planned which would allow detection and correction of problems. Furthermore, the

ITF could also have the same potential pollution problems as discussed above and as discussed in items 1 and 2 above.

4. ISFS Construction activities. See discussion in items 1, 2 and 3 above. In addition, construction activities include asphalt and concrete plants which may introduce pollutants to the environment.

INTERROGATORY NO. 2 - UTAH O: For each pathway identified in response to Interrogatory No. 1, identify each of the specific contaminants from PFS's sewer/wastewater system, the detention basin, ISFSI operations, and ISFSI construction activities that the State contends could enter the surface water and groundwater in Skull Valley, the means or mechanism by which each contaminant would enter each pathway, and the technical and scientific bases for the State's contentions.

RESPONSE TO INTERROGATORY NO. 2 - UTAH O:

See response to Interrogatory No. 1.

INTERROGATORY NO. 3 - UTAH O: Identify the likelihood that, in the State's belief, each of the contaminants identified in response to Interrogatory No. 2 would enter the surface water or groundwater in Skull Valley through each of the pathways identified in response to interrogatory No. 1, and the technical and scientific bases therefor, including, but not limited to, the scientific and technical basis for any radiological releases that the State asserts are likely to result in groundwater or surface water contamination.

RESPONSE TO INTERROGATORY NO. 3 - UTAH O:

See response to Interrogatories No. 1, 2 and 4.

INTERROGATORY NO. 4 - UTAH O: Identify each specific body of surface water - perennial and intermittent - that the State contends would be contaminated by the construction, operation, or decommissioning of the PFS ISFSI, and the technical and scientific bases therefor.

RESPONSE TO INTERROGATORY NO. 4 - UTAH O:

The State of Utah has provided PFS with a list of approximately 45 surface

waters at various radii from the storage site. See Response to Document Request No. 2 below. The State contends that all surface waters downgradient of the storage, ITF and those that are crossed with transport vehicles could be contaminated by the operations. For example, PFS indicates that the Low Corridor will cross 56 arroyos that can contain surface waters. Furthermore, contamination could occur from radiologics or any other contaminants used on the ISFSI site or the ITF. This could occur from accidents, spills, negligence or intentional acts.

INTERROGATORY NO. 5 - UTAH O: Identify and fully explain the specific respects in which the State contends that PFS has inadequately characterized the groundwater beneath the ISFSI site, including the respects in which the State contends PFS has inadequately characterized the groundwater depth (to the extent the State does not admit Request No. 2 above), the ground permeability, and the groundwater velocity, and the technical and scientific bases therefor.

RESPONSE TO INTERROGATORY NO. 5 - UTAH O:

PFS has not characterized the ground water beneath their 99 acre storage site. A site of this size would normally require several monitoring wells to determine the complete chemistry of the ground water across the site. This would also allow determining ground water depth at various locations (three or more) and to determine ground water flow direction. This is the basic information needed to understand the ground water at the site, predict potential impacts and detect future changes in ground water quality from operations. Ground water quality data is needed over a period of at least a year to identify seasonal variations. Similarly, localized permeability and velocity information is needed to predict potential impacts.

INTERROGATORY NO. 6 - UTAH O: Identify and fully explain any

measurable or adverse impacts on downgradient hydrological resources, and the mechanisms by which the State asserts such impacts would occur, that the State contends would result from the asserted contaminants and pathways identified in response to Interrogatories 1 and 2 above, and the technical and scientific bases therefor.

RESPONSE TO INTERROGATORY NO. 6 - UTAH O:

See response to Interrogatory No. 1 above.

INTERROGATORY NO. 7 - UTAH O: To the extent the State does not admit Request No. 1-4 above, identify and fully explain the specific adverse effects the State contends PFS's water usage would have on specific well users and the aquifer, and the technical and scientific bases therefor.

RESPONSE TO INTERROGATORY NO. 7 - UTAH O:

See response to Request for Admission Nos. 1 and 2.

C. Document Requests - Utah O

DOCUMENT REQUEST NO. 1 - UTAH O: All documents related to the claims raised by the State, as admitted by the Board, in Contention O.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH O:

See responses to documents requests below. In addition, the State has produced to the Applicant all relevant no-privileged documents.

DOCUMENT REQUEST NO. 2 - UTAH O: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention O.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH O:

In addition to non privileged documents already produced, the State has reviewed, considered and relied upon the license application submittal, as amended, responses to RAIs and documents produced by PFS. The State documents that the

State has generated and not yet produced to PFS are Surface Water Features for Proposed Nuclear Waste Storage Site, list of Springs Within the Skull Valley Watershed, list of Perennial Waters Within a 50 Mile Radius of the Proposed Storage Site, and list of Water Right Points of Diversion within a 10 mile radius. These are now available for inspection and copying at Ms. Nakahara's office at the Department of Environmental Quality.

DOCUMENT REQUEST NO. 3 - UTAH O: All documents supporting the State's assertion that under Utah law the PFSF detention basin must be designed to withstand the probable maximum flood.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH O:

The State objects to this Request as calling for a legal conclusion under Utah law. Notwithstanding this objection, the State refers PFS to Utah Code Ann Title 19, Chapter 5 and Utah Administrative Code R317-6 (Ground Water Quality Protection).

DOCUMENT REQUEST NO. 4 - UTAH O: All documents which the State agreed to produce during informal discovery but has yet to produce, including documents discussing the characteristics of groundwater in Skull Valley, the impacts from the PFSF, as well as applicable Utah standards.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH O:

See Response to Document Request No. 2. These are the only documents that the State is aware of that it has not yet produced to PFS. Examples of other documents that the State has already produced to PFS include, but are not limited to the following:

Bates nos. UT-15475-15479: Paper titled *Skull Valley Geohydrology (Excerpted from Utah's Cedar Mountains Siting SSC Proposal)*, presented to the Science Council.

Bates no. UT-15480-15495: Article published by Utah Geological Assoc.
Publication 21 titled *An Interpretation of the Water Chemistry and Hydrogeology of Skull Valley, Tooele County, Utah* by Thomas C. Chidsey.

VII. BOARD CONTENTION 13 (UTAH S) DECOMMISSIONING

A. Requests for Admissions – Utah S

ADMISSION REQUEST NO. 1 - UTAH S: Do you admit that PFS has a commitment (documented in RAI Response 1-7) from a bank to provide a letter of credit to cover PFSF decommissioning costs in the amount of \$1.7 million?

RESPONSE TO ADMISSION REQUEST NO. 1 - UTAH S:

Admit.

ADMISSION REQUEST NO. 2 - UTAH S: Do you admit that PFS has provided the wording for the letter of credit referred to in Request No. 1?

RESPONSE TO ADMISSION REQUEST NO. 2 - UTAH S:

Admit.

ADMISSION REQUEST NO. 3 - UTAH S: Do you admit that the letter of credit referred to in Request No. 1 would be irrevocable?

RESPONSE TO ADMISSION REQUEST NO. 3 - UTAH S:

Admit.

B. Interrogatories – Utah S

INTERROGATORY NO. 1 - UTAH S: To the extent that the State does not admit Requests Nos. 1-3, identify and fully explain the specific respects in which the State contends that the commitment PFS has obtained from a bank to provide a letter of credit to cover the decommissioning costs of the PFSF is inadequate to satisfy NRC requirements, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 1 - UTAH S:

Not applicable because the State has admitted Admission Request Nos. 1-3.

INTERROGATORY NO. 2 - UTAH S: Taking into account PFS's decommissioning cost breakdown provided in RAI Response 1-6 and PFS's plan to monitor and provide for future changes in decommissioning costs provided in RAI Response 1-8, identify and fully explain each specific respect in which the State and/or Confederated Tribes contend that PFS's decommissioning cost estimates for the PFS ISFSI are inadequate, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 2 - UTAH S:

The State has not completed its assessment and evaluation of the adequacy of the PFS decommissioning cost estimates and PFS's plan to monitor and provide for future changes in decommissioning costs. The following outstanding Requests for Admissions and Document Requests that the State has served upon PFS are related to the State's assessment and evaluation of these issues:

State of Utah's Second Set of Discovery Requests Directed to the Applicant - Contention S, Requests for Admissions Nos. 1 through 3 and Document Request No. 1.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention S, Requests for Admissions Nos. 1 through 18 and Document Requests Nos. 1 through 15.

Having noted this, and in light of the information currently at hand, the plan presented by PFS is insufficient to ensure that the site can be fully decontaminated and decommissioned. Factors supporting this conclusion include the following:

- PFS concedes that "the extent of any required decontamination efforts is not capable of being quantified at this time" and that "[a]ctual decontamination efforts and sequences of work will depend on facility operating history and whether any contamination actually exists." LA Appendix B Rev. 0, Page 2-1. In light of this acknowledged uncertainty, it

is not reasonable for PFS to assume for the purposes of its decommissioning plan that it need only budget for a "best case" or de minimus scenario of site decontamination and decommissioning based on its laudable pre-operational resolve to "start clean/stay clean" and desire not to have serious accidents. What is missing is an analysis providing reasonable assurance that adequate funds will be available to decontaminate the site taking this uncertainty about events into account. The health and safety of the public has to be maintained under any set of reasonably foreseeable outcomes. The fact that accident or natural event scenarios have a low probability of occurrence does not mean that they may be left out of the analysis.

Response to this part of State's response to Interrogatory No. 2 may contain proprietary information. See general explanation under Contention E as to the treatment of such information. The State's responses that may contain proprietary information are appended hereto as Addendum A and are fully incorporated herewith. As noted in the Mailing Certificate, the proprietary portion of the State's response will not be served on those parties whom the State understands have not entered into a confidential and non-disclosure agreement with the Applicant or who are not otherwise privy to this information.

- PFS asserts that while it cannot really know what decommissioning costs

will be involved given the uncertainties, it will "submit a final decommissioning plan . . . at least one year prior to the expiration of the license. The final decommissioning plan will address decontamination of the site." LA Appendix B Rev. 0, page 2-2. The fact that the final decommissioning plan will be done after the fact and in light of actual contamination of the site is no substitute for a plan that would provide reasonable assurance that funds will exist to decommission the site given the range of possibilities over the life of the facility.

INTERROGATORY NO. 3 - UTAH S: If the State and/or Confederated Tribes contend that any of PFS's cost estimates for the individual decommissioning tasks identified in RAI Response 1-6 are incorrect, provide the asserted correct costs of those tasks, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 3 - UTAH S:

The State has not completed its assessment and evaluation of the accuracy of the PFS estimates for the individual decommissioning tasks identified in RAI Response 1-6. The following outstanding Requests for Admissions and Document Requests that the State has served upon PFS are related to the State's assessment and evaluation of the accuracy of these individual decommissioning tasks:

State of Utah's Second Set of Discovery Requests Directed to the Applicant - Contention S, Requests for Admissions Nos. 1 through 3 and Document Request No. 1.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention S, Requests for Admissions Nos. 1 through 18 and Document Requests Nos. 1 through 15.

See also State's response to Interrogatory No.2 above for a review of PFS's

overall approach.

INTERROGATORY NO. 4 - UTAH S: If the State and/or Confederated Tribes contend that PFS has omitted to estimate the cost for any decommissioning tasks that the State and/or Confederated Tribes contend that PFS will be required to perform, identify and fully explain why each such task will need to be performed and the claimed cost for performing each such task and the bases therefor.

RESPONSE TO INTERROGATORY NO. 4 - UTAH S:

See responses to Interrogatories Nos. 2 and 3 - Utah S.

INTERROGATORY NO. 5 - UTAH S: Identify and fully describe the "large accidents and associated release or contamination" that the State and/or Confederated Tribes claim could occur at the PFSF which would impose decommissioning costs not accounted for in PFS's decommissioning cost estimate, including the mechanism(s) by which the State and/or Confederated Tribes claim such large accidents or release could occur, the specific physical consequences of the accident or release, and the scientific and technical bases therefor (including the bases for claiming such accidents or release are credible).

RESPONSE TO INTERROGATORY NO. 5 - UTAH S:

The State has not completed its assessment and evaluation of the large accidents and associated release or contamination that would impose decommissioning costs not accounted for in PFS's decommissioning cost estimate.

However, at the present time, the State believes that the "worst case" accident would involve:

1. Sabotage, the striking of a HI-STORM cask or casks with a MILAN or TOW-2 anti-tank missile, with a 1% or greater release of radioactive particulates and crud.
2. Impact of an F-16 jet engine or hanging bomb traveling at 600 mph with a HI-STORM cask or casks.

The economic costs of evacuation, interdiction of food supply, and decontamination have not yet been ascertained for a storage cask. The economic impact of a severe accident has been calculated by DOE for a smaller transportation cask, for a smaller percentage of cask inventory. For a cask containing 14 PWR fuel assemblies for a shipping cask (not 24 assemblies as in the HI-STORM 100) and a release in a rural area, Sandia has projected that the estimated contaminated area would be $4.3E+5$ square meters, with the cost of cleanup ranging between \$13 million and \$620 million (1985 dollars). The time for cleanup was projected to be 460 days. A 1% release would lead to far greater contamination and higher cleanup costs. The 1% release estimate arises from sabotage source term physical tests conducted by Sandia and Battelle Columbus Laboratories in 1981.

See the following documents:

Sandquist, GM et al, "Exposures and Health Effects from Spent Fuel Transportation," Rogers & Associates for the Department of Energy, RAE-8339/12-1, November 29, 1985.

Schmidt, EW et al, "Shipping Cask Sabotage Source Term Investigation," Battelle Columbus Laboratories, NUREG/CR-2472, December 1981.

Wilmot, EL, "Transportation Accident Scenarios for Commercial Spent Fuel," SAND80-2124, February 1981.

INTERROGATORY NO. 6 - UTAH S: Identify and fully specify the response that the State and/or Confederated Tribes contend would be required of PFS if the accident or release alleged in response to Interrogatory No. 5 were to occur, including the immediate cost of such response and the specific impact the accident or release would have on PFSF decommissioning costs, and the bases therefor.

RESPONSE TO INTERROGATORY NO. 6 - UTAH S:

The State has not completed its assessment and evaluation of the response that would be required of PFS if the accident or release alleged in the response to Interrogatory No. 5 were to occur. The following outstanding Requests for Admissions and Document Requests that the State has served upon PFS are related to the State's assessment and evaluation of the response that would be require of PFS if the accident or release alleged in the response to Interrogatory No. 5 were to occur:

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention S, Request for Admission No. 7 and Document Requests Nos. 6 and 7.

Nevertheless, to-date the State has identified that the costs and responses to a major accident or release are detailed in descriptions of RADTRAN computer code and emergency response documents such as Madsen, MM, et al, "RADTRAN III," Sandia National Laboratory, SAND84-0036, February 1986.

INTERROGATORY NO. 7 - UTAH S: Identify and fully specify each and every other non-routine expense which the State and/or Confederated Tribes contend that PFS has not included in its decommissioning cost estimate, including the bases for claiming such expenses will be incurred and the costs thereof.

RESPONSE TO INTERROGATORY NO. 7 - UTAH S:

See responses to Interrogatories Nos. 2 and 3 - Utah S.

INTERROGATORY NO. 8 - UTAH S: Describe in detail the site survey, including the cost of such a survey, which the State contends that PFS must perform upon decommissioning the PFSF and provide the bases therefor.

RESPONSE TO INTERROGATORY NO. 8 - UTAH S:

The State has not completed its assessment and evaluation of the site survey, including the cost of such a survey, that PFS must perform upon decommissioning the

PFSF. Nevertheless, to-date the State has determined that the type of site survey required is set forth in the following documents:

Berger, JD, "Manual for Conducting Radiological Surveys in Support of License Termination," NUREG/CR-5849, June 1992.

Huffert, AM et al, "Background as a Residual Radioactivity Criterion for Decommissioning," NUREG-1501, August 1994.

Daily, MC et al, "Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment," NUREG-1500, August 1994.

C. Document Requests - Utah S

DOCUMENT REQUEST NO. 1 - UTAH S: All documents related to the claims raised by the State and/or Confederated Tribes, as admitted by the Board, in Contention S (including those claims raised in Castle Rock Contention 7, as incorporated by Confederated Tribes).

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH S:

To date, the State has reviewed Chapter 10 of the License Application, the Environmental Report, the Draft Decommissioning Plan, the Safety Analysis Report, the Private Fuel Storage LLC Business Plans, PFS's responses to the NRC's Requests for Additional Information, and other documents obtained from PFS through discovery. The State also has reviewed the following publicly available documents related to Contention S:

1. Sandquist, GM et al, "Exposures and Health Effects from Spent Fuel Transportation," Rogers & Associates for the Department of Energy, RAE-8339/12-1, November 29, 1985.
2. Schmidt, EW et al, "Shipping Cask Sabotage Source Term Investigation," Battelle Columbus Laboratories, NUREG/CR-2472, December 1981.
3. Wilmot, EL, "Transportation Accident Scenarios for Commercial Spent Fuel,"

SAND80-2124, February 1981.

4. Madsen, MM, et al, "RADTRAN III," Sandia National Laboratory, SAND84-0036, February 1986.
5. Berger, JD, "Manual for Conducting Radiological Surveys in Support of License Termination," NUREG/CR-5849, June 1992.
6. Huffert, AM et al, "Background as a Residual Radioactivity Criterion for Decommissioning," NUREG-1501, August 1994.
7. Daily, MC et al, "Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment," NUREG-1500, August 1994.

See also response to Document Request No. 2, Utah Contention E. Non-publicly available documents related to Contention S that were not obtained from PFS are located at Ms. Nakahara's office at the Department of Environmental Quality.

DOCUMENT REQUEST NO. 2 - UTAH S: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State and/or Confederated Tribes with respect to Utah Contention S (including those claims raised in Castle Rock Contention 7, as incorporated by Confederated Tribes).

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 3 - UTAH S: All documents describing or otherwise relating to the decommissioning tasks that the State and/or Confederated Tribes contend that PFS must perform to decommission the PFSF.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 4 - UTAH S: All documents relating to the costs or cost estimates of the decommissioning tasks that the State and/or Confederated Tribes contend PFS must perform to decommission the PFSF.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 5 - UTAH S: All documents describing or otherwise relating to the site survey or components of the site survey that the State contends PFS must perform to decommission the PFSF.

RESPONSE TO DOCUMENT REQUEST NO. 5 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 6 - UTAH S: All documents relating to the costs or cost estimates of the site survey or components of the site survey that the State contends PFS must perform to decommission the PFSF.

RESPONSE TO DOCUMENT REQUEST NO. 6 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 7 - UTAH S: All documents supporting or otherwise relating to the State's and/or Confederated Tribes' assertion that an accident or radioactive release could occur at the PFSF, the cost of responding to which PFS has allegedly not included in its decommissioning cost estimate.

RESPONSE TO DOCUMENT REQUEST NO. 7 - UTAH S:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 8 - UTAH S: All documents relating to the cost of responding to and the impact on PFSF decommissioning costs that would be imposed by the accident or release referred to in Document Request No. 7.

RESPONSE TO DOCUMENT REQUEST NO. 8 - UTAH S:

See response to Document Request No. 1.

VIII. BOARD CONTENTION 15 (UTAH U) IMPACTS OF ONSITE STORAGE NOT CONSIDERED

A. Document Requests - Utah U

DOCUMENT REQUEST NO. 1 - UTAH U: All documents related to the claims raised by the State, as admitted by the Board, in Contention U.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH U:

The State has produced all documents, not privileged, related to State claims raised in Contention U. These are still available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State.

DOCUMENT REQUEST NO. 2 - UTAH U: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention U.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH U:

The State has produced all documents, not privileged, generated, reviewed, considered or relied upon by any expert or consultant with respect to Contention U. These are still available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State.

IX. BOARD CONTENTION 16 (UTAH V) TRANSPORTATION

A. Requests for Admission - Utah V

ADMISSION REQUEST NO. 1 - UTAH V: Do you admit that a dedicated train exclusively transporting heavy loads (such as spent fuel transportation casks) is less likely to have a derailling incident than a mixed-use train with both heavy and light loads?

RESPONSE TO ADMISSION REQUEST NO. 1 - UTAH V:

The State objects to this admission request because it is too vague.

Notwithstanding this objection, the State denies this request. Any response depends

crucially on the weight of the heavy loads, the number of engines and whether the train is moving on a steep downgrade.

B. Interrogatories - Utah V

INTERROGATORY NO. 1 - UTAH V: Identify and fully explain each specific respect in which the State claims that exceeding the threshold condition of Table S-4 of 100 tons per cask per rail car or 73,000 pounds per truck increases the environmental impact of transporting spent nuclear fuel, and provide the scientific and technical bases therefor.

RESPONSE TO INTERROGATORY NO. 1 - UTAH V:

The accident rate for Maxson-type rail cars is greater than for standard rail cars, according to discovery materials turned over to the State by PFS. In addition, the mixture of light and heavy cars can cause derailments, if a heavy car is at the back of the train, and several light cars are in the middle. This point was made by a Mr. Fronczak of the American Association of Railroads in the minutes of a National Technical Review Board meeting on November 20, 1997. In addition, heavy rail cars can lose brake power on steep downgrades. If an accident occurred leading to a release of radioactive materials, because of the greater spent fuel inventory in heavier casks, the accident could lead to a greater impact than the impact considered by the AEC in WASH-1238. The GE IF-300 rail cask considered there held seven PWR fuel assemblies, compared to 24 fuel assemblies in the Holtec and TranStor casks. Finally, the Maxson-type casks cannot fit into all reactor bays, requiring additional cranes and equipment to lift each cask onto a rail car outside of the reactor bay. This additional handling increases the likelihood of handling accidents.

C. Document Requests - Utah V

DOCUMENT REQUEST NO. 1 - UTAH V: All documents, data or other information related to the claims raised by the State, as admitted by the Board, in Contention V.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH V:

The State has produced all documents, not privileged, related to State claims raised in Contention V. These are available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State.

DOCUMENT REQUEST NO. 2 - UTAH V: All documents, data or other information generated, reviewed, considered, or relied upon by any expert or consultant in connection with assisting the State with respect to Contention V.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH V:

The State has produced all documents, not privileged, generated, reviewed, considered, or relied upon by any expert or consultant in connection with Contention V. These are still available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State. *See also* response to Document Request No. 6.

DOCUMENT REQUEST NO. 3 - UTAH V: All documents, data or other information supporting the State's assertions in Utah V, as admitted by the Board, including but not limited to:

- a. relevant documents, data or other information supporting the State's claimed "fact that heavier trains are more likely to lose braking on downgrades." State Petition at 147.

RESPONSE TO DOCUMENT REQUEST NO. 3.a. - UTAH V:

The following documents discuss heavy trains losing breaking on downgrades:

NTSB, "Southern Pacific Transportation Co. Freight Train 2nd BSM 22 Munitions Explosion, Benson AZ, May 24, 1973, NTSB RAR 75-2 (February 26, 1975); and

NTSB, "Railroad Accident Report - Derailment of Southern Pacific Transportation Company Freight Train on May 12, 1989, and Subsequent Rupture of CALNEV Petroleum Pipeline on May 25 . . . NTSB/RAR-90-02 (June 19, 1990).

DOCUMENT REQUEST NO. 3 - UTAH V: All documents, data or other information supporting the State's assertions in Utah V, as admitted by the Board, including but not limited to:

- b. relevant documents, data or other information that support the State's claim that "transportation casks, taken together with rail carriages, will weigh over 200 tons." Id.

RESPONSE TO DOCUMENT REQUEST NO. 3.b. - UTAH V:

PFS discovery documents show a total weight for the Hi-Star 100 transportation casks of 422,500 pounds or 211 tons. See, PFS document bates stamped 32859 by PFS, attached to a March 30, 1999 memo from John Donnell to Stan Gurule, apparently from PFS file folder entitled PFS Document Production 7, 4/23/99, Contention 1: Utah B, file number 185.1.

DOCUMENT REQUEST NO. 3 - UTAH V: All documents, data or other information supporting the State's assertions in Utah V, as admitted by the Board, including but not limited to:

- c. relevant documents, data or other information that support the State's claim that "[t]he heavier a cask is, the more difficult it will be to retrieve if it falls from a train, thus raising the risk of accidents." Id. at 148.

RESPONSE TO DOCUMENT REQUEST NO. 3.c. - UTAH V:

The State is examining the capacity of railroads to recover heavy objects, and

will produce the documents when our research is further along.

DOCUMENT REQUEST NO. 3 - UTAH V: All documents, data or other information supporting the State's assertions in Utah V, as admitted by the Board, including but not limited to:

- d. relevant documents, data or other information that support the State's claim that "once an accident occurs, the higher inventory of spent fuel inside the larger cask raises the consequences of a radiological release." Id.

RESPONSE TO DOCUMENT REQUEST NO. 3.d. - UTAH V:

This is self-evident, and thus no documents are needed to support.

DOCUMENT REQUEST NO. 4 - UTAH V: All records of conversation or any documentation (including data) produced due to the conversation between Marvin Resnikoff, RWMA, and Robert Fronczak, American Association of Railroads ("AAR") on November 20, 1997 and any other conversations on any date by the State of Utah or any of its consultants or experts with the AAR on the subject of shipment by rail. Id.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH V:

Dr. Resnikoff has no such records.

DOCUMENT REQUEST NO. 5 - UTAH V: All relevant documents, data or other information provided by the AAR regarding shipment of hazardous materials, including radioactive material, by rail.

RESPONSE TO DOCUMENT REQUEST NO. 5 - UTAH V:

The State has produced all documents related to AAR documents regarding shipment of hazardous materials, including radioactive material, by rail. These are still available for review at Ms. Connie Nakahara's office of the Department of Environmental Quality by coordination with counsel for the State.

DOCUMENT REQUEST NO. 6 - UTAH V: All documents, data or other information received from the NRC in the FOIA mentioned by Diane Curran at the Pre-hearing Conference when discussing Utah Contention V, including but not limited

to the Paperiello/Morrison Memorandum dated February 20, 1996. January 29, 1998 Prehearing Conference Transcript at 556.

RESPONSE TO DOCUMENT REQUEST NO. 6 - UTAH V:

FOIA documents responsive to Request No. 6 are available for inspection and copying in Ms. Nakahara's office at the Department of Environmental Quality.

Documents released by the NRC to the public under the FOIA requests are listed in the appendices of these FOIA requests and may be ordered by any person from the NRC's Public Document Room.

X. BOARD CONTENTION 17 (UTAH W) OTHER IMPACTS NOT CONSIDERED

Document Requests - Utah W

DOCUMENT REQUEST NO. 1 - UTAH W: All documents related to the claims raised by the State, as admitted by the Board, in Contention W.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH W:

Utah Contention N and Utah Contention W deal with the effects of flooding at the Intermodal Transfer Site. All documents relating to Contention W have been produced in connection with documents produced for Contention N. *See also*, State's May 21, 1999 Fourth Supplemental Response to Applicant's First Set of Formal Discovery Requests, relating to State's Contention N (flooding), in particular, Responses to Document Requests Nos. 1-7.

DOCUMENT REQUEST NO. 2 - UTAH W: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention W.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH W:

See Response to Document Request No. 1 above.

XI. BOARD CONTENTION 18 (UTAH Z) NO ACTION ALTERNATIVE

A. Interrogatories – Utah Z

INTERROGATORY NO. 1 - UTAH Z: Identify and fully explain each environmental advantage that the State claims results from the no-action alternative and describe fully the scientific, technical or other bases for each such claimed advantage.

RESPONSE TO INTERROGATORY NO. 1 - UTAH Z:

The State is unable to provide a complete answer to this question at this time because the answer would depend upon data requests currently outstanding to the applicant, and possible follow-up data requests and analysis of those and any other additional materials which the State may discover prior to the submission of testimony on this issue. The State will update this response as we receive these materials and complete its analyses. However, the State responds as follows with the data currently available:

- **Transportation risks:** There are substantial risks to people and resources in moving 40,000 MTU of high level radioactive waste along roads, highways and railways through heavily populated areas, through, over or along rivers, lakes, or other areas with substantial public significance and value. Given the geographical diversity in the location of the SNF currently, much of the nation will be at risk from the transportation of the SNF on an on-going basis for decades. See, for example, PFS's June 1998 Business Plan, section

on Financial Plan at bates no. 12145 marked confidential, from PFS file no. 061.2, entitled Contention 3 - Utah E/Castle Rock7/Confederated Tribe F.

- **Environmental impacts on BLM lands:** The rail spur from the junction between the main line and the PFS site is PFS's preferred option for carrying the high level radioactive waste to the site. The spur line would degrade wilderness areas of substantial environmental value. It would be a potential ignition source for wild land fires and a potential carrier of non-native weed species. If this option is finally adopted, 80,000 MTU of high level radioactive waste (40,000 in and 40,000 out) could move through those areas with attendant risks.
- **Peregrine Falcons:** Avoiding the increased noise, traffic, and construction activities related to the PFS facility which would interfere with nesting peregrine falcons in the Timpie Springs Wildland Management Area adjacent to Rowley Junction.
- **Risk from serious accidents or natural events at or near the PFS facility.** Sabotage, accidents involving military aircraft maneuvering at or near PFS's above ground storage of large amounts of high level radioactive waste. A serious accident could pose a threat to the lives and property of large numbers of people in this part of Utah.
- **Risks involved with moving the SNF a second time to a final disposal site.** PFS is emphatically not supposed to be a permanent or even semi-

permanent site for the storage of high level radioactive waste. See, e.g. January 1997 Revised Business Plan, section on the Mission Statement at bates no. 07897, marked confidential, apparently from PFS file no. 061.1, entitled Contention 3 - Utah E/Castle Rock 7/Confederated Tribes F. This means that the waste will have to be moved a second time via road, and/or highway to its next location. This next location may be at Yucca Mountain, or it may not. Id. The tonnage transport mileage may be substantial and even a single serious accident could entail widespread damage and loss of life or health to families along the routes to be used.

- Preservation of a presently undisturbed site in an area of cultural and historical significance to a number of groups, including Native Americans.
- Risk of Accidents from additional cask handling.
- Technology improvements: Even over the course of the last 20 years there has been a substantial evolution in nuclear industry technology and general technical knowledge. There is no reason to suppose that this process of technical evolution has come to a halt. This favorable process of technical change is being challenged and foreshortened by economic instability and restructuring in the electric utility industry and the desire of many nuclear utilities to get out from under their SNF now regardless of the long term consequences.
- The political, institutional and economic context of the PFS proposal are

fluid. The PFS proposal is a creature of a variety of short term factors.

Decisions with substantial long term ramifications and risks should not be based on short run economic factors. Put another way, an analysis based on short term economic and political factors is liable to produce an inferior decision when viewed from the longer term perspective.

INTERROGATORY NO. 2 - UTAH Z: Identify and fully explain each deficiency that the State claims exists with respect to the report prepared by Energy Resources International, Inc. ("ERI") for PFS entitled "Utility At-Reactor Spent Fuel Storage Costs for the Private Fuel Storage Facility Cost-Benefit Analysis," and describe fully the scientific, technical or other bases for each such claimed deficiency.

RESPONSE TO INTERROGATORY NO. 2 - UTAH Z:

The State has not completed its assessment and evaluation of the report prepared by ERI for PFS. The following outstanding Requests for Admissions and Document Requests that the State has served upon PFS are related to the State's assessment and evaluation of the ERI report:

State of Utah's Second Set of Discovery Requests Directed to the Applicant - Contention Utah E, Requests for Admission Nos. 2, 3 and 4 and Document Requests Nos 1 through 7 and 11 through 22.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention E, Requests for Admission Nos. 1 through 6 and Document Requests Nos. 1, 2, 3, 5, 7, 8, 14, and 15.

State of Utah's Third Set of Discovery Requests to the Applicant - Contention S, Requests for Admission, Nos. 1 and 3.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention Z, Document Requests Nos. 1 through 6.

Nevertheless, the State to-date has identified the following potential deficiencies

in the report prepared by ERI for PFS:

- The report does not consider the time value of money. Therefore, it presents a distorted and unrealistic view of the potential savings in future at-reactor spent fuel storage costs that would result from completion and operation of the PFS facility.
- The report does not reflect the potential impact on the marketability of capacity at the PFS facility of the Department of Energy proposal to assume the cost of storing spent nuclear fuel at reactor sites until the permanent repository is opened.
- The report does not reflect the potential impact of industry restructuring and sales of nuclear plants on the marketability of capacity at the PFS facility. For example, two of the reactors assumed by ERI to be interested in sending their spent nuclear fuel, TMI Unit 1 and Clinton, have recently been sold to Amergen, whose owner PECO is not a participant in PFS. Future nuclear plant sales may eliminate other potential sources of spent nuclear fuel for the PFS facility.

INTERROGATORY NO. 3 - UTAH Z: Identify and fully explain each deficiency that the State claims exists with respect to the analysis for a 40,000 MTU facility provided in response to EIS RAI 5-2(b), and describe fully the scientific, technical or other bases for each such claimed deficiency.

RESPONSE TO INTERROGATORY NO. 3 - UTAH Z:

The State has not completed its assessment and evaluation of the PFS analysis of a 40,000 MTU facility that was provided in response to EIS RAI 5-2(b). The following

outstanding Requests for Admissions and Document Requests that the State has served upon PFS are related to the State's assessment and evaluation of the PFS analysis:

State of Utah's Second Set of Discovery Requests Directed to the Applicant - Contention Utah E, Requests for Admission Nos. 2, 3 and 4 and Document Requests Nos 1 through 7 and 11 through 22.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention E, Requests for Admission Nos. 1 through 6 and Document Requests Nos. 1, 2, 3, 5, 7, 8, 14, and 15.

State of Utah's Third Set of Discovery Requests to the Applicant - Contention S, Requests for Admission, Nos. 1 and 3.

State of Utah's Third Set of Discovery Requests Directed to the Applicant - Contention Z, Document Requests Nos. 1 through 6.

Nevertheless, the State to-date has identified the following potential deficiencies in the PFS analysis:

- The analysis does not consider the time value of money. Therefore, it presents a distorted and unrealistic view of the potential savings in future at-reactor spent fuel storage costs that would result from completion and operation of the PFS facility.
- The analysis report does not reflect the potential impact on the marketability of capacity at the PFS facility of the Department of Energy proposal to assume the cost of storing spent nuclear fuel at reactor sites until the permanent repository is opened.
- The analysis does not reflect the potential impact of industry restructuring and sales of nuclear plants on the marketability of capacity at the PFS

facility. For example, two of the reactors assumed by ERI to be interested in sending their spent nuclear fuel, TMI Unit 1 and Clinton, have recently been sold to Amergen, whose owner, PECO, is not a participant in PFS. Future nuclear plant sales may eliminate other potential sources of spent nuclear fuel for the PFSF.

B. Document Requests - Utah Z

DOCUMENT REQUEST NO. 1 - UTAH Z: All documents, data or other information related to the claims raised by the State, as admitted by the Board, in Contention Z.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH Z:

To date, the State has reviewed the License Application, the Environmental Report, the Safety Analysis Report, the Private Fuel Storage LLC Business Plans, the ERI "Utility At-Reactor Spent Fuel Costs for the Private Fuel Storage Facility Cost Benefit Analysis" and the related series of May and June 1997 memoranda from Eileen Supko to Scott Northard and John Parkyn, PFS's responses to the NRC's Requests for Additional Information, and the other documents obtained from PFS through discovery. The State also has reviewed the following publicly available documents related to Contention Z:

"The Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste," prepared by Planning Information Corporation for the Nevada Nuclear Waste Project Office, September 1996, available at the website of the State of Nevada Nuclear Waste Project Office.

See also response to Document Request No. 2, Utah Contention E. Non-publicly available documents related to Contention E that were not obtained from PFS

are located at Ms. Nakahara's office at the Department of Environmental Quality.

DOCUMENT REQUEST NO. 2 - UTAH Z: All documents, data or other information generated, reviewed, considered, or relied upon by any expert or consultant in connection with assisting the State with respect to Contention Z.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH Z:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 3 - UTAH Z: All documents, data or other information - including any documents, data or other information generated by any expert or consultant assisting the State - developed from the State's review and evaluation of (i) the ERI report "Utility At-Reactor Spent Fuel Storage Costs for the Private Fuel Storage Facility Cost-Benefit Analysis," (ii) PFS's response to EIS RAI 5-2(b), and (iii) any supporting data or calculations provided to the State as a result of discovery.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH Z:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 4 - UTAH Z: All documents, data or other information supporting or otherwise relating to the State's assertion in Utah Z that the following are environmental advantages for the no-action alternative:

See response to Document Request No. 1.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH Z:

DOCUMENT REQUEST NO. 5 - UTAH Z: All documents, data or other information supporting or otherwise relating to the State's assertions in its responses to Interrogatory Nos. 1 - 3 above.

RESPONSE TO DOCUMENT REQUEST NO. 5 - UTAH Z:

See response to Document Request No. 1.

XII. BOARD CONTENTION 19 (UTAH AA) RANGE OF ALTERNATIVES

A. Requests for Admissions

REQUEST FOR ADMISSION NO. 1 - UTAH AA: Do you admit that the Applicant considered 38 alternative sites in its site selection process?

RESPONSE TO ADMISSION REQUEST NO. 1 - UTAH AA:

Admit that ER Chapter 8 (Rev. 1, page 8.1-2) says 38 sites were evaluated; admit that the 1998 Revision of the PFS Business Plan at bates no. 12014 says that in April and May 1996 reviews were completed of 36 sites.

REQUEST FOR ADMISSION NO. 2 - UTAH AA: Do you admit that the Applicant sent a questionnaire to at least three candidate sites requesting detailed information on the suitability of locating an ISFSI at each site?

RESPONSE TO ADMISSION REQUEST NO. 2 - UTAH AA:

Admit that ER Chapter 8 Rev. 1, page 8.1-5 says that questionnaires were sent to the "owners/promoters of the remaining (3) candidate sites.

REQUEST FOR ADMISSION NO. 3 - UTAH AA: Do you admit that the Applicant received responses from at least three candidate sites to the questionnaire requesting detailed information on the suitability of locating an ISFSI at the sites?

RESPONSE TO ADMISSION REQUEST NO. 3 - UTAH AA:

Admit that ER Chapter 8 Rev. 1, page 8.1-5 implies that completed questionnaires were received from the three candidate sites to which the questionnaires were sent, although the State is unable to identify the location of a positive reference to support the Applicant's assertion.

ADMISSION REQUEST NO. 4 - UTAH AA: Do you admit that the Applicant visited at least three of the candidate sites to review the suitability of locating an ISFSI at the sites?

RESPONSE TO ADMISSION REQUEST NO. 4 - UTAH AA:

Admit that ER Chapter 8, Rev. 1, page 8.1-5 says "a major engineering firm . . . was engaged to conduct a field evaluation visit to each of the remaining (3) candidate sites."

ADMISSION REQUEST NO. 5 - UTAH AA: Do you admit that the Applicant conducted a comparative field investigation and evaluation of the Skull Valley site and the Fremont County site near Shoshoni Wyoming.

RESPONSE TO ADMISSION REQUEST NO. 5 - UTAH AA:

Admit.

B. Interrogatories - Utah AA

INTERROGATORY NO. 1 - UTAH AA: Identify and fully explain each respect in which the State claims that the Applicant's analysis of alternative sites was deficient and describe fully the scientific, technical, regulatory or other bases for each such claimed deficiency.

RESPONSE TO INTERROGATORY NO. 1 - UTAH AA:

The State is unable to provide a complete answer to this question at this time, because the answer would depend upon data requests currently outstanding to the Applicant, possible follow-up data requests and analysis of those and any other additional materials which we may discover prior to the submission of testimony on this issue. The State will update this response as we receive these materials and complete our analyses. Having said this, and in light of the materials the State currently has, the following set forth some of the problems with PFS's analysis of alternatives:

- The estimated construction cost of the project (not counting pads, casks and

canisters) is \$100 million. PFSF LA RAI No.1 Question 1-4 p.2 of 2. This construction cost estimate does not include a "backup offload capability." Supko, on the other hand, when comparing costs between onsite storage versus storage at PFS, assumes that the NRC will require such a capability. See December 1997 Supko Report by Energy Resources International, at bates no. 07743, marked as confidential, from PFS file no. 066.1 entitled Contention 18 - Utah Z. If PFS relies on Supko's assumptions for the estimation of costs for dry cask storage at reactor sites, then the same assumption should be made in the PFS analysis for the same reason. Failure to do so substantially understates the relative cost of the PFS facility and biases the analysis.

- PFS does not develop and compare other options, for example, the possibility of meeting the same need through reprocessing contracts.
- PFS's comparison of alternatives does not consider and evaluate the possibility that DOE will offer to take possession of the SNF at reactor sites and pay for its storage.
- PFS's review of alternatives does not include a DOE above-ground storage site at Yucca Mountain by 2007.

Response to this part of Interrogatory 1, Utah AA, may contain proprietary information. See general explanation under Contention E as to the treatment of such

information. The State's responses that may contain proprietary information are appended hereto as Addendum A and are fully incorporated herewith. As noted in the Mailing Certificate, the proprietary portion of the State's response will not be served on those parties whom the State understands have not entered into a confidential and non-disclosure agreement with the Applicant or who are not otherwise privy to this information.

INTERROGATORY NO. 2 - UTAH AA: Identify and fully explain each respect in which the State claims that the detailed questionnaire requesting information (at Table 8.1-2 of the Environmental Report) that the Applicant sent to the remaining candidate sites in the third phase of the site selection process was deficient and describe fully the scientific, technical, regulatory or other bases for each such claimed deficiency.

RESPONSE TO INTERROGATORY NO. 2 - UTAH AA:

Whether or not the five page "Site Selection Questionnaire" is "deficient" depends upon the role it plays in PFS's overall process of analyzing alternatives: how it was used, how it was followed up, the adequacy of the data it elicited, and how it was complemented (or not) by other data collection and analytical activities in the process.

INTERROGATORY NO. 3 - UTAH AA: Identify and fully explain each respect in which the State claims that the Applicant's comparative field investigation and evaluation of the Skull Valley site and the Fremont County site near Shoshoni Wyoming was deficient and describe fully the scientific, technical, regulatory or other bases for each such claimed deficiency.

RESPONSE TO INTERROGATORY NO. 3 - UTAH AA:

The State is continuing to analyze the NEPA contentions and so is unable to provide a complete answer to this question at this time. Moreover, because the answer would depend upon data requests currently outstanding to the Applicant, and possible

follow-up data requests and analysis of those and any other additional materials which the State may discover prior to the submission of testimony on this issue. The State will update this response as it receive these materials and completes its analyses.

In addition, the question is ambiguous. It may be that the focus of the question is on some broader process, but it seem more likely, and the State assumes that the question refers to possible deficiencies in Stone & Webster Engineering Corporation's *Field Investigation Evaluation Report*. See PFS document bates numbered 10011-10048 and marked confidential, apparently from PFS file no. 067.1 entitled Contention 19 - Utah AA/Castle Rock 13. The adequacy of this Report depends upon the role it played in PFS's overall decision making process, i.e. what other data went into the decision process, how this Report was used, how it was followed up by PFS, the adequacy of its foundational data, and the role the report played in the decision to adopt the PFS Skull Valley site.

C. Document Requests - Utah AA

DOCUMENT REQUEST NO. 1 - UTAH AA: All documents, data or other information related to the claims raised by the State, as admitted by the Board, in Contention AA.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH AA:

See response to Document Request No. 2, Utah Contention E.

DOCUMENT REQUEST NO. 2 - UTAH AA: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention AA.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH AA:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 3 - UTAH AA: All documents, data or other information – including any documents, data or other information generated by any expert or consultant assisting the State – developed from the State’s review and evaluation of the Applicant’s site selection process.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH AA:

See response to Document Request No. 1.

DOCUMENT REQUEST NO. 4 - UTAH AA: All documents, data or other information supporting or otherwise relating to the State’s assertions in its responses to Interrogatory Nos. 1 - 3 above.

RESPONSE TO DOCUMENT REQUEST NO. 4 - UTAH AA:

See response to Document Request No. 1.

XIII. BOARD CONTENTION 20 (UTAH DD) ECOLOGY AND SPECIES

A. Interrogatories – Utah DD

INTERROGATORY NO. 1 - UTAH DD: Identify each possible impact that State claims that the Applicant has not addressed or evaluated with respect to peregrine falcons nesting on the Timpie Springs Waterfowl Management Area and describe fully the State’s scientific, technical, or other bases for each such claimed impact.

RESPONSE TO INTERROGATORY NO. 1 - UTAH DD:

The Applicant has not addressed or has inadequately evaluated the following potential impacts relative to peregrine falcons nesting on the Timpie Springs Waterfowl Management Area ("WMA").

First, the Applicant has not adequately addressed or evaluated the impact on the peregrine falcon of increased rail and vehicle traffic. The ER states that materials for

concrete aggregate needed for construction the storage pads will be brought to the proposed ISFSI site from a quarrying operation located somewhere in Tooele County. The volume of traffic from this operation will be substantial and may pass near the Timpie Springs WMA. According to the ER, traffic hauling materials for concrete aggregate is estimated at an average of 299 truck trips per day (30 vehicles per hour) during the first part of Construction Phase 1 and 453 truck trips per day (46 vehicles per hour) during the second part of phase 1 construction. See ER at 4.1-5 and 4.1-13.

Additionally, 260 passenger vehicle trips per day will be added by PFS construction workers. Id. at 4.1-14. These truck and passenger vehicle trips increase the average daily traffic from 325 at present to 884 vehicles per day. Id. at 4.1-5 and Table 4.1-3. Although the Applicant carefully restricts its description of this major increase in traffic to "Skull Valley Road south of Iosepa," given the road conditions over Johnson's Pass, the majority of these trucks and workers may well use the Timpie Springs exit at I-80 as their route to and from the site.

Increased truck, rail and passenger vehicle traffic can potentially increase disturbance to nesting and foraging falcons. Passing trucks, trains, and other vehicles may cause nesting falcons to flush from nests and/or foraging perches. Flushing from foraging perches decreases foraging efficiency and may lead to starvation of nestlings; flushing from nests increases the possibility of egg breakage, and predation of eggs or nestlings, and may lead to nest abandonment. Further, the Applicant has not adequately evaluated the effects of construction activities during the breeding season in

the vicinity of the Timpie Springs nest site. Such construction activities increase human traffic and noise and may lead to nest abandonment or even site abandonment. Additionally, an increase in traffic can increase the possibility of direct mortality to falcons through collisions with trains, trucks or vehicles.

Second, the Applicant has not adequately addressed impacts to the peregrines' prey taxa, primarily prey items in the Timpie Springs WMA and Horseshoe Springs area. Prey items include waterfowl, shorebirds, swallows, mourning doves, gulls, terns, and songbirds (*see e.g.*, ER Appendix 2B). Impacts to peregrines and their prey may be affected by rail or site construction, increased truck, rail, or passenger vehicle traffic (*see discussion above*) or affected by potential transport of radionuclides from prey to predators (*see discussion below*)

Third, the Applicant has not addressed the potential loss of prey habitat though damage to wetlands, particularly Timpie and Horseshoe Springs wetland complexes, caused by rail construction and other project activities. Drainage from construction sites is, in most cases, into the Timpie and/or Horseshoe Springs areas. Timpie Springs provides the primary foraging site for the Timpie Springs falcons. Horseshoe Springs is likely to support prey taxa which are used by the Timpie Springs falcons. Damage to either wetland would likely reduce populations of peregrine prey species. Any contamination from construction, transportation, or other activities associated with the ISFSI operation, into Timpie or Horseshoe Springs would have significant ecological effects. In addition, peregrines may also forage in the ITF area. The

Applicant has not assessed or evaluated the potential loss of prey in the ITF area.

Fourth, the Applicant has not addressed the impacts of prey species exposed to radiation, which may transport radionuclides to peregrine falcons. It does not appear that songbirds will be effectively excluded from the PFS facility and they may possibly nest within the PFS facility. Moreover, these species will be able to forage on insects (possibly exposed to radiation) at the PFS facility. Peregrines may then consume exposed prey taxa. And while peregrines may not forage at the PFS facility, it is much more likely that widely foraging prey species (e.g., swallows) that forage or nest at or near the PFS site will also use areas where peregrines regularly hunt.

INTERROGATORY NO. 2 - UTAH DD: Identify fully the information on pocket gopher mounds that the State claims must be included in the License Application and describe fully the State's scientific, technical, regulatory or other bases for why such information must be included in the Application.

RESPONSE TO INTERROGATORY NO. 2 - UTAH DD:

Mounds characteristic of pocket gophers are indicative of the current presence of pocket gophers. Such pocket gopher mounds are easily recognizable by trained mammalogists. The Applicant's Environmental Report states: "No evidence of pocket gopher mounds were [sic] observed at the PFSF site in June 1996, October 1996 or February 1997." See ER, Rev. 1 at 2.3-16. The Applicant did not describe any methodology it used to support this statement. For example, the ER failed to provide specific details demonstrating whether an adequate search had been made to find either pocket gophers or evidence of their presence (i.e., their mounds). Such details should include:

- (1) The name of the persons conducting the survey for gophers or their mounds.
- (2) The qualifications of those who conducted such searches (e.g., background and experience in mammalogy, particularly in the study of gophers).
- (3) Exactly when the searches for gophers or their mounds took place and the weather conditions, such as temperature and precipitation, during the time of the search, and record of the evidence.
- (4) The amount of time spent in field searches for gophers or evidence of gophers (i.e., in person-hours).
- (5) The exact locations where searches for gophers or evidence of gophers were conducted.
- (6) The size of the area searched.
- (7) The methods employed in field searches. For example, were transect lines through the site walked and visually inspected for evidence of gophers, and, if so, how far apart were such transects and how were the transects arranged relative to the site and its boundaries.
- (8) Whether searches for gophers or evidence of gophers were made along the road that leads to the site. Furthermore, pocket gophers do forage and move about on the surface and do cross roads; thus, increased vehicular traffic to the PFSF site represents a potential threat to them.

INTERROGATORY NO. 3 - UTAH DD: Identify fully the characteristics that differentiate the Skull Valley pocket gopher from the other pocket gophers in

Skull Valley and the surrounding region.

RESPONSE TO INTERROGATORY NO. 3 - UTAH DD:

The Skull Valley pocket gopher (*Thomomys bottae robustus*) is distinguishable from other pocket gophers in Skull Valley and surrounding regions in several ways. First, it was formerly a Category 2 Candidate (see, for example, 56 Fed. Reg. 58810 (November 21, 1991) and 59 Fed. Reg. 58989 (November 15, 1994)) for potential listing by the U. S. Fish and Wildlife Service ("USFWS") as threatened or endangered under provisions of the Endangered Species Act until Category 2 was eliminated by the USFWS on 28 February 1996. USFWS, in eliminating Category 2, however, made it clear, in various statements at the time, that the Service still considered the taxa (i.e., species and subspecies) that had formerly been Category 2 Candidates to be of conservational concern and that the elimination of Category 2 did not signify that such taxa were secure, and, further, that it was the Service's hope that others would continue to direct appropriate attention to the former Category 2 Candidates.

Second, there are various physical differences between the *T. robustus* subspecies and other pocket gopher species. From the related species the northern pocket gopher (*Thomomys talpoides*), all subspecies of Botta's (or the valley) pocket gopher (*Thomomys bottae*) - including the Skull Valley pocket gopher (*Thomomys bottae robustus*) - can be distinguished with certainty by two skull characteristics: (1) the presence of a sphenorbital fissure and (2) anterior openings of the infraorbital canals not being posterior to the anterior palatine foramina.

These two species also generally differ in pelage coloration, the northern pocket gopher (*Thomomys talpoides*) usually being brownish and Botta's pocket gopher (*Thomomys bottae*) usually being grayish, blackish, or ochraceous. The Skull Valley subspecies of Botta's pocket gopher (*Thomomys bottae robustus*) is known to range in color from Pale Smoke Gray through Cinnamon Buff to Dark Mouse Gray. (Capitalized color terms are established standards set out by Ridgway, R., 1912, Color Standards and Color Nomenclature, Washington, D. C., i-iv, 1-44, 53 plates.)

The Skull Valley subspecies (*Thomomys bottae robustus*) can be distinguished from the two other subspecies of Botta's pocket gopher (*Thomomys bottae albicaudatus* and *Thomomys bottae stansburyi*) that occur near it (to the east and northeast, respectively), by the following:

- (1) It is larger and paler than *Thomomys bottae stansburyi* and has a compact, ridged, and angular skull, unlike *Thomomys bottae stansburyi*, which is smaller and darker and has a weak, smooth, small skull.
- (2) It is smaller and paler than *Thomomys bottae albicaudatus*, its postauricular patches are smaller and lighter, and its skull is smaller, more compact, and more nearly flat. Numerous other skull characteristics also serve to distinguish the Skull Valley pocket gopher (*Thomomys bottae robustus*) from *Thomomys bottae albicaudatus*. See Durrant, S. 1952, Mammals of Utah, Taxonomy and Distribution; Univ. Kansas Publ. Mus. Natur. Hist. vol. 6, 1-549 pp.

INTERROGATORY NO. 4 - UTAH DD: Identify each respect in which the State contends that the Applicant has not "adequately assessed the impact" on

Pohl's milkvetch and small spring parsley and describe fully the State's scientific, technical, or other bases for each respect in which the State claims such inadequate assessment.

RESPONSE TO INTERROGATORY NO. 4 - UTAH DD:

In PFS's discussion under "Ecology of the PFSF Site and Access Corridor" (*see*, ER, Rev. 1 § 2.3.1), the presence or absence of potential habitat for Pohl's milkvetch within the project area is not addressed. The nearest known location for Pohl's milkvetch is approximately 0.4 mile south in T5S, R8W, S9 (Kass 1998), near enough to make potential habitat within the project area a significant point of discussion. Though Pohl's milkvetch was not found within the project area during the year of the survey, if potential habitat is present, it may appear in subsequent years. The Applicant should describe in detail how the presence of Pohl's milkvetch (and its habitat) will be addressed if found during the construction period.

To date, the State has no further information than that already described in its Contention (*see*, Utah Contention DD and bases thereto, filed November 23, 1997). The State would note that the Utah Natural Heritage Program rankings for small spring parsley have changed; they are G5T2T3 / S2S3 (UNHP 1999).

INTERROGATORY NO. 5 - UTAH DD: Identify and describe fully the private domestic animal (livestock) and the domestic plant (farm produce) species in the area which the State claims that the Applicant has not identified nor assessed adverse impacts.

RESPONSE TO INTERROGATORY NO. 5 - UTAH DD:

As more fully describe in Response to Interrogatory No. 6 below, the Applicant has not identified nor assessed the effects of low levels of radiation exposure

from the PFS site to individual farming operations in the area; the impacts of the PFS facility on the beekeeping industry in Tooele County; and the potential impact the PFS facility may have on the alteration of the food chain.

INTERROGATORY NO. 6 - UTAH DD: Identify each adverse impact that the State claims that the Applicant has not assessed with respect to the private domestic animal (livestock) or the domestic plant (farm produce) species in the area and describe fully the State's scientific, technical, or other bases for each such claimed impact.

RESPONSE TO INTERROGATORY NO. 6 - UTAH DD:

The Applicant's assessment in its ER and amendments thereto of the impact of its facility on private domestic animal (livestock) and domestic plant (farm produce) species in the area is inadequate in several aspects. First, there is no evidence that any studies of the individual farming operations near the PFS facility were conducted to evaluate low level radiation exposure effects over the life of the facility. Nor have such effects been evaluated for the agricultural products produced for personal use, with the exception that the Applicant has made some attempt to discuss the effects of its facility on beef and milk. See ER, Rev. 2, Ch. 5, § 5.1.3. The individuals involved in small farming operations typically utilize smaller animals and products from their management to fulfill their daily nutritional needs, and protective and recreational outlets. Animals such as goats, sheep, chickens, ducks, dogs and cats provide for the human population in the area around the site.

The effects of the potential increase in background radiation to either the human or animal systems have not been adequately addressed in the current

environmental report. While the Applicant discusses a potential for off-normal contamination release in the ER, it does not evaluate the actual increase in background radiation that will occur from a large number of casks stored at the PFS site over the life of the facility. By present transportation standards, a reading of 200mrem/h could legally be reached at the surface of the transportation vessel. 10 CFR § 71.47. Multiplied by the large number of casks that are to be stored at the PFS site, an increase in the background radiation in the area of the PFS site is a certainty and should be evaluated in the ER.

Second, the ER includes no study of the facility's impacts on the beekeeping industry in Tooele County. There are 37 registered bee owners throughout Tooele County and at least two large migratory bee operations that summer their bees in the county. This equates to approximately 800 hives active through the spring and summer months, with annual honey production in the neighborhood of 90,000 pounds. See Annual Report of Tooele County Bee Inspection, 1997, Vance Keel. Movement of honey bees will not be impeded by any security measures at the PFS site. The resultant exposure to low-level radiation from the stored casks potentially could impact a population of bees, their hive, and ultimately the honey they produce for human consumption.

Third, there has been no mention of the potential for food chain alteration due to low level radiation from the site and the effect of small ecological alteration of insect life, which effects could be compounded up the food chain. The Applicant has not

evaluated the effect of food chain alteration due to low level radiation on the feeding habits of small rodents and birds, the potential for genetic change in these species, and the potential for harm to larger predators through changes in their food chain. Additionally, the potential for harm to larger birds of prey that nest near the PFS site and the ITF, and the ultimate effects of the exposure over a long period to the individuals who may be living in the area by their choice or their birthright have not been evaluated by the Applicant.

B. Document Requests - Utah DD

DOCUMENT REQUEST NO. 1 - UTAH DD: All documents related to the claims raised by the State, as admitted by the Board, in Contention DD.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH DD:

See Response to Document Request No. 3 below. In addition, all documents, not privileged, have already been produced.

DOCUMENT REQUEST NO. 2 - UTAH DD: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention DD.

RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH DD:

See Response to Document Request No. 1.

DOCUMENT REQUEST NO. 3 - UTAH DD: All documents, data or other information supporting or otherwise relating to the State's assertions in its responses to Interrogatory Nos. 1 - 5 above.

RESPONSE TO DOCUMENT REQUEST NO. 3 - UTAH DD:

In addition to the Applicant's Environmental Report as most recently amended and responses to EIS RAIs, the following documents were reviewed in preparation for

the State's Response to Interrogatory No. 4:

Kass, R. J. 1998. Private fuel storage facility rare plant inventory, Skull Valley Utah. Unpublished report prepared by Intermountain Ecosystems L.L.C. for Stone & Webster Engineering Corp, 22 June 1998. 10 pp.

UDWR (Utah Division of Wildlife Resources). 1997. Biological Assessment, Private Radionuclide Storage Facility, Goshute Indian's Skull Valley Reservation, Tooele County, Utah. 27 March 1997. Unpaginated.

Utah Natural Heritage Program, Utah Department of Natural Resources, June, 1999. Element Occurrence Database. Salt Lake City, Utah.

In addition to the Applicant's Environmental Report as most recently amended and responses to EIS RAIs, the following documents were reviewed in preparation for the State's Response to Interrogatory Nos. 5 and 6:

1998 Utah Agricultural Statistics.

Annual Report of Tooele County Bee Inspection, 1997, Vance Keel.

Office of the Surgeon General, Department of the Army, Textbook of Military Medicine, Series on Combat Casualty Care.

See also, Response to Document Request No. 1.

XIV. BOARD CONTENTION 21 (UTAH GG) FAILURE TO DEMONSTRATE CASK-PAD STABILITY

A. Interrogatories - Utah GG

INTERROGATORY NO. 1 - UTAH GG: Identify and fully explain each and every basis for the State's claim that "the coefficient of friction may vary over the surface of the pad" and what effect this assertion, if correct, would have on the stability of the TranStor storage casks and the pads during a seismic event.

RESPONSE TO INTERROGATORY NO. 1 - UTAH GG:

The Applicant's calculations already concede the premise that the coefficient of

friction, m , may vary atop the pads and that sliding will occur. See Response to Interrogatory No. 2, below. For example, the Applicant did not know the appropriate value of m to use in the assessment of the sliding stability of the pad foundation. Stone and Webster Calculation 05996.01, G(B) 04. Thus, values of m were parametrically varied from 0.00 to 0.67 to calculate the horizontal inertial force transferred to the pad foundation. Although the State may not agree with this range, it concurs that there is potential variation in m for several reasons: (1) variations in the construction and finish of the concrete surface atop the pads, (2) cold bonding that may potentially occur underneath the casks with time, (3) weathering and dusting of the exposed concrete surface due to freeze-thaw, concrete deterioration, and other environmental factors (*i.e.*, dust, precipitation, etc.), (4) a drop in m as sliding is initiated during the design earthquake (*i.e.*, shift from the static case to the dynamic case).

INTERROGATORY NO. 2 - UTAH GG: Identify and fully explain each and every basis for the State's claim that the casks will "shift from the static case to the kinetic case" during seismic activity and what effect this assertion, if correct, would have on the stability of the TranStor storage casks and the pads during a seismic event.

RESPONSE TO INTERROGATORY NO. 2 - UTAH GG:

The geotechnical design and the evaluation of the factor of safety against sliding at the interface between the soil and the bottom of the pad are predicated on the assumption that the casks will slide during the design earthquake ("DE"). Stone and Webster Calculation 05996.01, G(B) 04, "Stability Analyses of Storage Pads." In this calculation, values of the horizontal inertial force have been reduced according to a range of assumed values of the coefficient of sliding friction. Thus, if the casks do not

slide during the DE (i.e., do not shift from the static to the dynamic case), the Applicant's assumed condition is incorrect, Stone and Webster Calculation 05996.01, G(B) 04, "Stability Analyses of Storage Pads," and the stability of the pad at the foundation level has not been demonstrated.

In the preliminary geotechnical design of the pad foundation, the case of sliding of the casks on the concrete pad was not considered. Sliding stability requirements was "originally developed assuming that the casks were to be rigidly attached to the pads, so that the full inertia [sic] forces of the casks due to the earthquake would be transmitted to the pads." However, for that scenario, it was found that a frictional material placed at the base of the pads would not be capable of providing the necessary resistance to sliding. Interoffice Memorandum, Geotechnical Design Criteria, JO/WO 05996.01, 4/3/97, p. 1.

Later, the geotechnical designers learned that the possibility of cask sliding on top of the pads had been introduced into the seismic design. Interoffice Memorandum, Geotechnical Design Criteria, JO/WO 05996.01, 4/3/97, p. 1.

Based on my telephone conversation with you on March 21, 1997, I understand that the casks will not be attached to the pads, but, rather they will be placed on top of the pads, and resistance to sliding between the casks and the pads will be a function of the coefficient of friction between the bottom of the casks (steel) and the top of the pads (concrete).

Interoffice Memorandum, Subject Geotechnical Design Criteria, JO/WO 05996.01, 4/3/97, p. 1.

Subsequently, it appears that the Applicant modified its stability analyses to

take credit for reduced inertial forces due to assumed sliding of the casks. Stone and Webster Calculation 05996.01, G(B) 04, "Stability Analyses of Storage Pads." Thus, if cask sliding does not occur, a fundamental premise of the foundation design is violated and an unknown condition exists, which may jeopardize the sliding stability of the pads.

In addition, if cask sliding is allowed for in the design, and does occur during the DE, the Applicant's calculations and conclusions suggest that the factor of safety against sliding may be inadequate for a pad placed on granular fill. Stone and Webster Calculation 05996.01, G(B) 04, p. 48. Because of this, it appears that the Applicant decided to not place engineered fill underneath the cask pads, but rather, to place the pads directly over the native soil (i.e., silts, clayey silt and silty clay). This allowed the seismic sliding stability calculation to take credit for an assumed high cohesion of the native soil, which in turn produced an assumed "factor of safety greater than 1.1 for seismic stability." Stone and Webster Calculation 05996.01, G(B) 04, p. 48.

However, the factor of safety against sliding and the recommendation of the above calculation are potentially in error because the full value of the undrained shear strength (C_u) of 2200 psf was used to determine the pad's resistance to sliding. Stone and Webster Calculation 05996.01, G(B) 04, p. 13. Also, other sliding stability calculations used the full value of C_u . See "Storage Pad Analysis and Design," Civil Engineering Consultants, 6/17/97, pp. 179-180. This is not in accordance with standard geotechnical practice for evaluating resistance to sliding. Geotechnical

practice is to use the soil's adhesion (Ca), and not cohesion (Cu) . Naval Facilities Design Manual, NAVFAC DM - 7.2, p. 7.2-63 suggests that for very stiff cohesive soil (2000 to 4000 psf), typical adhesion values (Ca) range from 950 to 1300 psf, and not the 2200 psf used in the design. Because of this, the conclusion that native soils will provide adequate resistance to sliding of the pads has not been demonstrated, either for the case of cask sliding, or for the non-sliding case.

Ultimately, the state does not believe it is prudent to design for, or to allow sliding of the casks during the DE. Any such design, and its supporting calculations, that require sliding of the casks to significantly reduce inertial foundation loads are questionable. Such calculations, even under idealized conditions, are fraught with uncertainty, because there are a significant number of parameters and assumptions involved in the calculation, whose variation could readily change the conclusion. A more prudent and safe design requires the anchoring of the casks to the pads and the full consideration of the inertial forces that result from that anchorage.

B. Document Requests - Utah GG

DOCUMENT REQUEST NO. 1 - UTAH GG: All documents related to the claims raised by the State, as admitted by the Board, in Contention GG.

RESPONSE TO DOCUMENT REQUEST NO. 1 - UTAH GG:

The State has produced all non-privileged documents to the Applicant. *See also* response to Documents Requests for Contention L.

DOCUMENT REQUESTS NO. 2 - UTAH GG: All documents, data or other information generated, reviewed, considered or relied upon by any expert or consultant in connection with assisting the State with respect to Utah Contention GG.

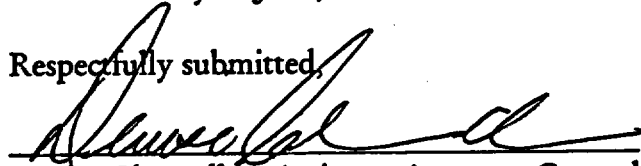
RESPONSE TO DOCUMENT REQUEST NO. 2 - UTAH GG:

In addition to the PFS submittals to the NRC, including but not limited to the License Applicant, Safety Evaluation Report, Calculation Package, and RAI responses, the State has used the following document with respect to Contention GG:

NAVFAC, 1982, Foundations and Earth Structures, Design Manual 7.2, May 1982, Department of the Navy, Naval Facilities Engineering Command, 200 Storall Street, Alexandria, VA 22332.

DATED this 28th day of June, 1999.

Respectfully submitted,



Denise Chancellor, Assistant Attorney General
Fred G Nelson, Assistant Attorney General
Diane Curran, Special Assistant Attorney General
Connie Nakahara, Special Assistant Attorney General
Attorneys for State of Utah
Utah Attorney General's Office
160 East 300 South, 5th Floor, P.O. Box 140873
Salt Lake City, UT 84114-0873
Telephone: (801) 366-0286, Fax: (801) 366-0292

CERTIFICATE OF SERVICE

I hereby certify that a copy of STATE OF UTAH'S OBJECTIONS AND RESPONSES TO APPLICANT'S SECOND SET OF DISCOVERY REQUESTS WITH RESPECT TO GROUPS II AND III CONTENTIONS was served on the persons⁶ listed below by electronic mail (unless otherwise noted) with conforming copies by United States mail first class, this 28th day of June, 1999:

Emile L. Julian, Assistant for
Rulemaking & Adjudications
Rulemaking & Adjudication Staff
Secretary of the Commission
U. S. Nuclear Regulatory Commission
Washington D.C. 20555
E-mail: hearingdocket@nrc.gov
(original and two copies)

G. Paul Bollwerk, III, Chairman
Administrative Judge
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, DC 20555
E-Mail: gpb@nrc.gov

Dr. Jerry R. Kline
Administrative Judge
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, DC 20555
E-Mail: jrk2@nrc.gov
E-Mail: kjerry@erols.com

Dr. Peter S. Lam
Administrative Judge
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, DC 20555
E-Mail: psl@nrc.gov

Sherwin E. Turk, Esq.
Catherine L. Marco, Esq.
Office of the General Counsel
Mail Stop - 0-15 B18
U.S. Nuclear Regulatory Commission
Washington, DC 20555
E-Mail: set@nrc.gov
E-Mail: clm@nrc.gov
E-Mail: pfscase@nrc.gov

Jay E. Silberg, Esq.
Ernest L. Blake, Jr.
Shaw, Pittman, Potts & Trowbridge
2300 N Street, N. W.
Washington, DC 20037-8007
E-Mail: Jay_Silberg@shawpittman.com
E-Mail: ernest_blake@shawpittman.com
E-Mail: paul_gaukler@shawpittman.com

⁶ Those persons marked with an asterisk (*) were not served with Addendum A, which may contain proprietary information (see general explanation under State's responses to Utah Contention E).

John Paul Kennedy, Sr., Esq.*
1385 Yale Avenue
Salt Lake City, Utah 84105
E-Mail: john@kennedys.org

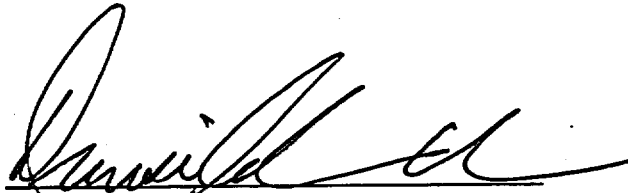
Richard E. Condit, Esq.*
Land and Water Fund of the Rockies
2260 Baseline Road, Suite 200
Boulder, Colorado 80302
E-Mail: rcondit@lawfund.org

Joro Walker, Esq.*
Land and Water Fund of the Rockies
2056 East 3300 South Street, Suite 1
Salt Lake City, Utah 84109
E-Mail: joro61@inconnect.com

Danny Quintana, Esq.*
Danny Quintana & Associates, P.C.
50 West Broadway, Fourth Floor
Salt Lake City, Utah 84101
E-Mail: quintana@xmission.com

James M. Cutchin*
Atomic Safety and Licensing Board
Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
E-Mail: jmc3@nrc.gov
(*electronic copy only*)

Office of the Commission Appellate
Adjudication*
Mail Stop: 16-G-15 OWFN
U. S. Nuclear Regulatory Commission
Washington, DC 20555
(*United States mail only*)



Denise Chancellor
Assistant Attorney General
State of Utah

EXHIBIT 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel
Storage Installation)

)
)
)
)
)
)

Docket No. 72-22-ISFSI

ASLBP No. 97-732-02-ISFSI

June 25, 1999

DECLARATION OF M. LEE ALLISON, Ph.D.

I, M. Lee Allison, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, relating to Utah Contention L, limited to Responses to Admission Requests Nos. 1 through 4, and the Geomatrix Study, in particular to Interrogatory Responses Nos. 1, 2, and part of 5, are true and correct to the best of my knowledge, information and belief.

Executed this 25th day of June, 1999.

By:



M. Lee Allison, Ph.D.
Director
Utah Geological Survey
Utah Department of Natural Resources

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD


In the Matter of:	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 24, 1999

DECLARATION OF DR. WALTER J. ARABASZ

I, Dr. Walter J. Arabasz, hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the factual statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to Interrogatories Nos. 3 and 4 for Utah Contention L and responses to document requests relating thereto.

Dated this 24th day of June, 1999.

By:



Walter J. Arabasz, PhD
Research Professor of Geology and Geophysics,
University of Utah;
Director, University of Utah Seismograph Stations

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

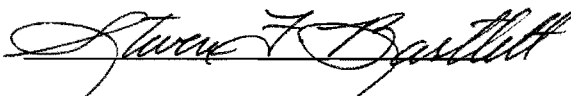
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 23, 1999

DECLARATION OF DR. STEVEN F. BARTLETT

I, Dr. Steven F. Bartlett, hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to responses for Utah Contentions L and GG (collapsible soils, soil characterization and sampling program); Utah Contention O (Admission Request No. 3 - groundwater characterization); and corresponding responses to document requests.

Executed this 23rd day of June, 1999.

By: 

Steven F. Bartlett, Ph.D., P.E.
Research Project Manager, Research Division
Utah Department of Transportation

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

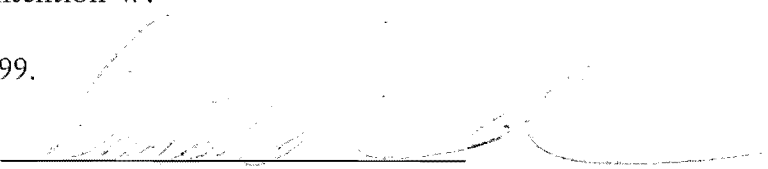
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 28, 1999

DECLARATION OF DENISE CHANCELLOR, ESQ.

I, Denise Chancellor, Esq., declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to responses to General Discovery Requests and Document Requests for Contention W.

Executed this 28th day of June, 1999.

By: 
Denise Chancellor, Esq.
Assistant Attorney General
Utah Attorney General's Office

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

)
) Docket No. 72-22-ISFSI
)

PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel
Storage Installation)


) ASLBP No. 97-732-02-ISFSI
)
) June 17, 1999

DECLARATION OF CHRIS S. CRNICH, DVM

I, Chris S. Crnich, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 28, 1999, relating to Utah Contention DD, limited to livestock and farm produce, are true and correct to the best of my knowledge, information and belief.

Executed this 17th day of June, 1999.

By: _____


Chris S. Crnich, DVM
Manager
Meat and Poultry Inspection Bureau
Utah Department of Agriculture

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:)	
	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 16, 1999

DECLARATION OF MERTON A. FRANKLIN

I, Merton A. Franklin, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 25, 1999, relating to Utah Contention DD, limited to Pohl's milkvetch and small spring parsley, are true and correct to the best of my knowledge, information and belief.

Executed this 16th day of June, 1999.

By:

Merton A. Franklin

Merton A. Franklin
Botanist
Utah Natural Heritage Program
Utah Division of Wildlife Resources
Utah Department of Natural Resources

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

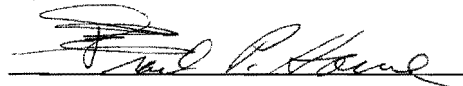
In the Matter of:	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 16, 1999

DECLARATION OF DR. FRANK P. HOWE

I, Dr. Frank P. Howe, hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 18, 1999, relating to Utah Contention DD, limited to peregrine falcons, are true and correct to the best of my knowledge, information and belief.

Executed this 16th day of June, 1999.

By:



Frank P. Howe, PhD
Non-Game Avian Program Coordinator
Utah Division of Wildlife Resources
Utah Department of Natural Resources

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

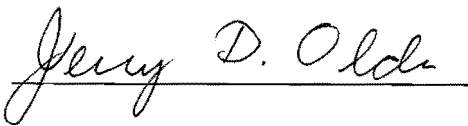
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:)	
	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 24, 1999

DECLARATION OF JERRY D. OLDS, P.E.

I, Jerry D. Olds, P.E., hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the factual statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to responses for Utah Contention O (Admission Request Nos. 1 and 2, and part of Interrogatory No. 7 - water usage); and corresponding responses to document requests.

Executed this 24rd day of June, 1999.

By: 
Jerry D. Olds, P.E.,
Assistant State Engineer,
Division of Water Rights
Utah Department of Natural Resources

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD


In the Matter of:)	
	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 16, 1999

DECLARATION OF GEORGE V. OLIVER

I, George V. Oliver, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 18, 1999, relating to Utah Contention DD, limited to pocket gophers, are true and correct to the best of my knowledge, information and belief.

Executed this 16th day of June, 1999.

By: _____


George V. Oliver
Chief Zoologist
Utah Natural Heritage Program
Utah Division of Wildlife Resources
Utah Department of Natural Resources

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

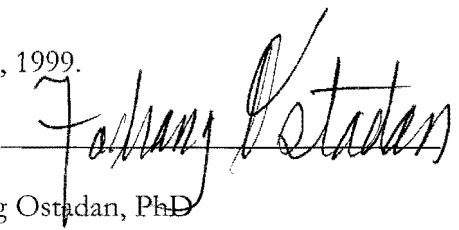
In the Matter of:)	
	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 15, 1999

DECLARATION OF DR. FARHANG OSTADAN

I, Dr. Farhang Ostadan, hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 18, 1999, relating to Utah Contentions L and GG, limited to soil dynamics and soil-structure interaction, are true and correct to the best of my knowledge, information and belief.

Executed this 15th day of June, 1999.

By:


Farhang Ostadan, PhD
Consultant for Soil Dynamics and Soil Structure
Interaction

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:)	
	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 23, 1999

DECLARATION OF DON A. OSTLER, P.E.

I, Don A. Ostler, P.E., hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the factual statements contained in State of Utah's Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to responses for Utah Contention O (with the exception of water usage) and corresponding responses to document requests.

Executed this 23rd day of June, 1999.

By: _____

Don A. Ostler, P.E.
Director, Division of Water Quality
Department of Environmental Quality

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel)	
Storage Installation)	)	June 24, 1999

DECLARATION OF DR. MARVIN RESNIKOFF

I, Dr. Marvin Resnikoff, hereby declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, to be filed on June 28, 1999, are true and correct to the best of my knowledge, information and belief, as they relate to Utah Contentions II, U, and V; and with respect to Utah Contentions E and S, limited to worst case accident scenarios.

Dated this 24th day of June, 1999.

By: 

Marvin Resnikoff, PhD,
Senior Associate
Radioactive Waste Management Associates

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

)
) Docket No. 72-22-ISFSI
)

PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel
Storage Installation)

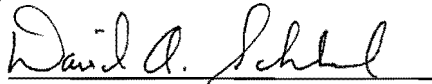
) ASLBP No. 97-732-02-ISFSI
)
) June 18, 1999
)

DECLARATION OF DAVID A. SCHLISSEL

I, David A. Schlissel, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 28, 1999, relating to Utah Contentions E, S, Z, and AA, are true and correct to the best of my knowledge, information and belief.

Executed this 18th day of June, 1999.

By:



David A. Schlissel
President
Schlissel Technical Consulting, Inc.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

)
) Docket No. 72-22-ISFSI
)

PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel
Storage Installation)


) ASLBP No. 97-732-02-ISFSI
)
) June 21, 1999
)

DECLARATION OF MICHAEL F. SHEEHAN, Ph.D.

I, Michael F. Sheehan, declare under penalty of perjury and pursuant to 28 U.S.C. § 1746, that the statements contained in State of Utah's Objections and Response to Applicant's Second Set of Discovery Requests with Respect to Groups II and III Contentions, dated June 28, 1999, relating to Utah Contentions E, S, Z, and AA, are true and correct to the best of my knowledge, information and belief.

Executed this 21st day of June, 1999.

By:



Michael F. Sheehan, Ph.D.
Osterberg & Sheehan

EXHIBIT 2

May 1999

MICHAEL F. SHEEHAN

Address: 33126 Callahan Road
Scappoose, Oregon 97056

Born: January 1, 1946
Brooklyn, New York

Marital Status: Married, two children

Education: J.D. (With Distinction) College of Law, University of Iowa,
May 1987.

Ph.D. (Economics) University of California at Riverside,
June 1979

Master of Arts (Economics)
University of California at Riverside, June 1973

Bachelor of Science (Economics, Magna Cum Laude)
University of California at Riverside, June 1972

Professional Licenses: Admitted to the Iowa Bar (June 1987).

Admitted to the Bar of the U.S. District Court for the
Northern District of Iowa (July 1987).

Admitted to the Oregon Bar (April 1988).

Admitted to the Bar of the U.S. District Court for the District
of Oregon (April 1990).

Admitted to the Bar of the Ninth Circuit Court of Appeals
(February 1992).

Academic References: Professor Peter Fisher
Graduate Program in Urban and Regional Planning, The
University of Iowa, Iowa City, Iowa 52242.

Professor Greg Hayden, Department of
Economics, University of Nebraska, Lincoln,
Nebraska 68510.

Professor K.C. Kogiku
Tsu 602-40 Tsu
Kamakura City
Japan 248

Professor Barney Hope
Department of Economics
California State University
Chico, CA 95929
916-898-4836 off FAX: 916-898-6889

Prof. Harry Trebing
Institute of Public Utilities
Michigan State University
Olds Hall, Rm. 113
East Lansing, MI 48824
517-355-1876 Hm: 517-349-1828

Prof. Marc Tool
Department of Economics
California State University
Sacramento, CA 95819-2694
off: 916-278-6945 Dept: 916-278-6223; Hm: 916-457-2782

Professor Richard Moss, Department of Economics,
California State College, San Bernardino, California 92407.

Teaching Fields: Public Utility Economics and Planning
State & Local Economic Development
Natural Resources and Environmental
Economics
Operations Research (Quantitative
Economics)
Law and Economics

**Research Interests
and Expertise:** Public Utilities
State & Local Economic Development
Analysis of Risk and Environmental Safety
Law and Economics

Languages: Spanish

Articles in Academic Journals:

"The Problem of Mass Evictions in Mobile Home Parks Subject to Conversion." 8 *Journal of Affordable Housing & Community Development Law* 231 Spring 1999.

"Why Ramsey Pricing is Wrong: The Case of Telecommunications Regulation: A Response to Harkenrider." *Journal of Economic Issues* (December 1993).

"Mobile Home Rent Control: Designing Local Regulations." *Land Use Law* 3 (November 1992) (With Roger Colton).

"Ramsey Pricing Without Cross-Subsidization? A Response to Professor Becker." *Journal of Economic Issues* (December 1991).

"Monopoly, the Holding Company, and Asset Stripping: The Case of Yellow Pages." *Journal of Economic Issues*, (March 1992). (Equal authors with Evan White).

"A Clarification of the Concept of 'Instrumental Valuation' in Neoinstitutional Economics." *Journal of Economic Issues* (March 1992). (Second author with Rick Tilman).

"Why Ramsey Pricing is Wrong: The Case of Telecommunications Regulation." *Journal of Economic Issues* (March 1991).

"Raising Local Government Revenues Through Utility Franchise Charges: If the Fee Fits Foot It". 21 *Urban Lawyer* 55 (Winter 1989). (With Roger Colton).

"Institutionalists Before Regulatory Commissions: The Value of Doing in Thinking, Teaching, and Writing" *Journal of Economic Issues*, December 1988.

"Corporate Control and the Decapitalization of Subsidiary Corporations: The Looting of the Bangor and Aroostook Railroad." *Journal of Economic Issues*, September 1988.

"A New Basis for Conservation Programs for the Poor: Expanding the Concept of 'Avoided Costs,'" *National Clearinghouse Review*. June 1987 (with Roger Colton).

"Seven-Cum-Eleven: Rolling the Toxic Dice in the U.S. Supreme Court," *Boston College Environmental Affairs Law Review*. V. 14, #3 (1987) (with Roger Colton and Kathleen Uehling).

"Regulatory Control of Natural Gas Procurement Practices in Illinois: Permissible Regulation or Preempted Activity?" 35 *DePaul Law Review* 317 (1986)(with Roger Colton). Reprinted in *Public Utility Law Anthology* v. IX (1986).

"Plant Closings and the Community: The Instrumental Value of Public Enterprise," *American Journal of Economics and Sociology*, V. 44, #4, October 1985.

"Institutional Development of Water Supply in California: The Miller-Lux Water Monopoly Controversy," *Social Science Journal*, V. 22, No. 1, January, 1985 (with Barney Hope, equal authors).

"The Political Economy of Centralized Water Supply in California," *Social Science Journal*, V. 20, #2, April 1983 (with Barney Hope, equal authors).

"Land Speculation in Southern California: The Roles of Railroads, Trolley Lines and Automobiles," *The American Journal of Economics and Sociology*, V. 41, #2, April 1982.

"Land Speculation in Southern California: Energy Monopoly, Fiscal Crisis and the Future," *The American Journal of Economics and Sociology*, V. 42, No. 1, January, 1983.

"The Importance of the Burden of Proof in Environmental Regulation," *The Environmental Professional*, V. 4, 1982.

"Possibilities for Local Public and Cooperative Ownership of Short Line Railroads," *Transportation Research Record*, 802 (1981), (with Peter Fisher).

"Game Theory Analyses Applied to Water Resource Problems," *Socio-Economic Planning Sciences*, V. 15, #3, (1981), (Sheehan, Kogiku). Reprinted in Kiichiro Kogiku, ed., *Resource Allocation Models: Essays on the Management of Resources and the Environment*, Tokyo (Aoyama Gakuin University Press) 1990.

"Policy Problems Associated with Waterborne Asbestos," *The Water Resources Bulletin*, April 1981, V. 17, #2.

"Reply to Discussion of 'Policy Problems Associated With Waterborne Asbestos,'" *The Water Resources Bulletin*, February 1983, V.19, #1. ("Discussion" by Michael Edson and Wm. Thompson in the same issue).

"Coordinating Public Utility Expansion, Industrial Siting and Pollution Control: A Workable Dynamic Programming Algorithm," *Socio-Economic Planning Sciences*, April 1977, V. 11, (Sheehan, Kogiku). Reprinted in Kiichiro Kogiku, ed., *Resource Allocation Models: Essays on the Management of Resources and the Environment*, Tokyo (Aoyama Gakuin University Press) 1990.

Articles in Trade Publications:

Employment and Jobs: The Employment Impact of Federal Environmental Investments National Commission for Employment Policy; Washington D.C. April 1995 (Research Report 95-02). With Skip Laitner and Marshall Goldberg.

"Utility Franchise Charges and the Rental of City Property," in *New Jersey Municipalities* December 1995, p.10ff.

"Cash for Clunkers Program Can Hurt the Poor." *State Legislatures* 33 (May 1993) (with Roger Colton).

Books:

On the Brink of Disaster: A State by State Analysis of Low-Income Natural Gas Heating Bills (Flying Pencil Publications: Scappoose, OR 1994) (With Roger Colton).

Articles in Books:

"Raising Local Government Revenues Through Utility Franchise Charges: If the Fee Fits Foot It," Reprinted in Freilich and Bushek, eds., *Exactions, Impact Fees and Dedications: Shaping Land-Use Development and Funding Infrastructure in the Dolan Era*, ABA, Chicago, 1995; p.233ff (With Roger Colton).

"Whose Goals and Whole Alternatives? How Bad Can a Private Goal Be and Still Define the EIS Under NEPA?," Presented to the National Park & Public Land Symposium, to be reprinted. (On the New World Mine proposal) 1995.

"Law and Economic Policy: The Institutional Contribution." In Warren Samuels ed., *Handbook of Evolutionary and Institutional Economics* (M.E. Sharpe, forthcoming).

"The Allocation of Wildfire Control Investments." (With Kiichiro Kogiku, equal authors) chapter 3 in Kiichiro Kogiku, ed., *Resource Allocation Models: Essays on the Management of Resources and the Environment*, Tokyo (Aoyama Gakuin University Press) 1990.

"A System Simulation Analysis of New Strategies for Long-run Cost Minimization in Wildfire Control." (With Kiichiro Kogiku, equal authors) chapter 4 in Kiichiro Kogiku, ed., *Resource Allocation Models: Essays on the Management of Resources and the Environment*, Tokyo (Aoyama Gakuin University Press) 1990.

"An Application of Multi-criteria Decision-making to Multiple Use Planning in U.S. Forests." (With Kiichiro Kogiku, equal authors) chapter 5 in Kiichiro Kogiku, ed., *Resource Allocation Models: Essays on the Management of Resources and the Environment*, Tokyo (Aoyama Gakuin University Press) 1990.

"An Analysis of Davenport City Finances." Appendix 6B (p. 181-191) in G. Daniels & K. Gagala, *Labor Guide to Negotiating Wages and Benefits*, Reston (Prentice-Hall), 1985 (with Peter Fisher).

"The Struggle Between the Electric Utility Industry and Small Scale Power Producers: Law, Politics and Economics in State and Federal Policymaking." Chapter 6 in Max Neiman and Barbara Burt, eds. *The Social Constraints on Energy Policy Implementation*, Lexington, D.C. Heath & Co. 1983.

"Economism, Democracy, and Hazardous Wastes: Some Policy Considerations" in Kamieniecki, O'Brien and Clarke, *Controversies in Environmental Policy*, Albany, SUNY Press, 1986.

"Nonrenewable Resources and the Development of Arid Lands: A Planning Approach," in *Alternative Strategies for Desert Development and Management*, UNITAR, Pergamon Press, 1979 (Adam Rose, Michael Sheehan, Dale Hurd).

**Professional
Administration:**

Member, Board of Directors, Association for Evolutionary Economics 1999-

Managing Partner, Osterberg and Sheehan,
Public Utility Economists, Iowa City.

Past Member, Research Advisory Committee, National
Regulatory Research Institute.

Past Member, Board of Editors, *Journal of Economic Issues*

Editor, *Reports on the Iowa Economy*.

Past-President, Association for Institutional Thought (AFIT)
(1988-9).

**Professional & Legal
References:**

Matthew Glasson Esq., Glasson, Grove and Sole, Cedar
Rapids, Iowa.

Ellen Johnson, Oregon Legal Services,
Hillsboro, Oregon.

David Girard, Columbia Legal Services,
Seattle.

Michael Mullett, General Counsel, Citizens Action Coalition,
Indianapolis, IN.

Mark Smith, Secretary-Treasurer, Iowa State Federation of
Labor, Des Moines, Iowa.

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**Utility-Related
Law Practice**

Ameritech Petition to the Indiana Utility Regulatory
Commission for Further Deregulation. Cause 40849. 1997-
8. Representing Citizen Action Coalition of Indiana, AARP
and United Seniors in Action.

*Petition of CAC et al for an Investigation into the Rates and
Charges of Ameritech Indiana.* Cause 41058. Representing
Citizen Action Coalition of Indiana, AARP and United
Seniors in Action. November 1997.

Indiana Bell Telephone dba Ameritech Indiana v. IURC et al
(Before the Indiana Court of Appeals). February 1998.
Representing Citizen Action Coalition of Indiana, AARP and
United Seniors in Action.

*Indiana Utility Regulatory Commission Investigation into All
Matters Relating to Access Charge and Universal Service
Reform.* Cause 40785. 1997-8. Representing Citizen Action
Coalition of Indiana, AARP and United Seniors in Action.

*In the Matter of the Application of U.S. West for an Increase
in Revenues* Docket UT 125 (Rate design) Before the
Oregon Public Utility Commission. 1997-8. Representing
AARP.

*In the Matter of the Petition of US West for a Ruling
Clarifying the Effect of Rate Reductions on Refund
Obligations* Docket UT 143 Before the Oregon Public
Utilities Commission. Representing AARP. 1997-8.

*US West Communications, Inc. v. Oregon Public Utilities
Commission,* CA A101358, Before the Oregon Court of
Appeals. Representing the Citizens Utility Board of Oregon
and AARP. August 1998.

**Practice Before
Courts (Economics):**

Shiprack v. Keisling, Secretary of State of the State of Oregon
No. 98C-17750 Review of statistical sampling methodology
for signature count to qualify initiatives. Fall 1998.

Aspenwall et al v. Parker NW Paving, Circuit Court for the
County of Multnomah. Calculation of gross value of sand
and gravel deposits. 1998.

Croctic v. Golden Pacific Homes, Multnomah County Circuit
Court Action. Consumer Fraud. Before an arbitrator.
Calculation of present value of damages. May 1998.

Green v. Sunpointe Associates, Civil Action No. C96-1542C
(U.S. Dist. Ct. Western District of Washington). Fair
Housing Act Class Action. Calculation of damages. 1997.

Garneau v. City of Seattle, Federal District Court. "Seattle's
Low-Income Tenant: Relocation Assistance Ordinance: A
Review of Professor Heyne's Economic Analysis." On behalf
of Evergreen Legal Services and the City of Seattle in
defense of the TRA0. January 1995.

Pacific Northwest Bell v. Eachus et. al.
(OPUC), Multnomah County Circuit Court.
Affidavits & testimony in support of CUB's resistance to (1)
Bell's request for a stay of a commission rate reduction order,
and (2) Bell's request for a protective order. On behalf of
Oregon Citizens' Utility Board. (Spring 1990).

Azul Pacifico v. City of Los Angeles. Federal District Court
for the Central District of California. Witness statement (33
pages) and oral testimony on the economics of mobilehome
rent control. On behalf of the City of Los Angeles. (January
1990).

IN RE: John & Reta Martin: Chapter 12
Bankruptcy. "Materials in Support of an Analysis of the
Appropriate Interest Rate Under 11 USC Section 1225(a)(5);"
and "Moody's Corporate Bond Composite: An Analysis in
Light of 11 USC 1129(b)." Fixed interest rate determination
in support of plan confirmation. Written reports. April
1987. Bankruptcy Court (ND, Iowa).

IN RE: De Los and Donna Martins: "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report. April 1987. Bankruptcy Court (ND, Iowa).

IN RE: Paul and Gretchen Pothoven: "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report plus testimony. April 1987. Bankruptcy Court (SD, Iowa).

"An Economic Analysis of Rules Adopting 6 Percent and \$6000 Limits on Excludable Assets Essential for Self-Support in Determining Medicaid Eligibility." A report (affidavit) prepared for Legal Services Organization of Indiana. February 1987.

IN RE: Merlin & Helen Theisen: "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report. February 1987. Bankruptcy Court (ND, Iowa).

IN RE: L.C. & Gladys Cole: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report plus testimony. February 1987. Bankruptcy Court (ND, Iowa).

IN RE: Donald & Sharalee Kurtenbach: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report in lieu of testimony. February 1987. Bankruptcy Court (ND, Iowa).

IN RE: Manta C. Noe and John & Carol Noe: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC 1129(b)(2)." Fixed interest rate determination in support of cramdown. Written report plus testimony. February 1987. Bankruptcy Court (ND, Iowa).

IN RE: Leland & Evelyn Eganhouse: Chapter 11 Bankruptcy. "The Use of the Farm Profitability Index to Index Annual Payments Under the Reorganization Plan." Written report. July 1986.

IN RE: Robert & Joann Pestka: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report. July 1986.

IN RE: Leland & Evelyn Eganhouse: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report. July 1986.

IN RE: Wilbert Wuebker: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report. May 1986.

The Maine Association of Independent Neighborhoods, et. al. and Nancy Haggan v. Michael Petit Docket No. 83-0360-B, The U.S. District Court for the District of Maine. "An Economic Analysis of Rules Adopting 6 Percent and \$6000 Limits on Excludable Assets Essential for Self-Support in Determining Medicaid Eligibility." A report prepared for Pine Tree Legal Assistance, Inc. of Augusta, Maine. May 1986. (Favorable Decision: U.S. Dist. Ct. D. Maine, April 23, 1987. Docket No. 85-0174-B).

IN RE: Paul Kaufman: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report. April 1986.

IN RE: John & Marie McAllister: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed and variable interest rate determinations; written report plus testimony. March 1986.

IN RE: Byron & Connie Greiman: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report. March 1986.

IN RE: Cyrus & Annette Hopkins: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination; written report plus testimony. March 1986.

IN RE: Daniel & Helen Wolf: Chapter 11 Bankruptcy. "Materials in Support of an Analysis of the Appropriate Interest Rate Under 11 USC Section 1129(b)(2)." Fixed interest rate determination in support of the debtors successful cramdown effort. Written report plus testimony. February 1986.

**Practice Before
Regulatory
Commissions:**

In the Matter of Investigation and Hearing on Possible Reduction in Rates and Charges of Entergy New Orleans, Inc. for Electric and Gas Service in New Orleans Docket No. UD-97-1. Before the New Orleans City Council. May-June 1997. Expert written testimony on the franchise agreement. On behalf of the Alliance for Affordable Energy.

Petition of Northern Indiana Public Service Company for Approval of a Natural Gas Alternative Regulatory Plan. Before the Indiana Utility Regulatory Commission. Expert written testimony on the proposal. On behalf of Citizens Action Coalition of Indiana. February 1997. (Settled).

With Respect to Setting Rates Pursuant to Franchise for the Forest Grove Transfer Station. Before the METRO Council (Portland, Oregon). Preparation of studies and other materials. On behalf of the Metro Staff. 1996-7.

Hydro Resources Inc. Application to Construct and Operate the Crownpoint Uranium Solution Mining Project at Crownpoint, NM, Before the U.S. Nuclear Regulatory Commission. Docket No. 40-8968. 1997. Review of the economics of the proposal (issues related to financial capability, cost benefit analysis and need). On behalf of ENDAUM and the Southwest Research and Information Center.

In Re Indianapolis Power and Light Cause No.39938. Written rebuttal testimony on rate base, rate of return, and estimation of plant value. Before the Indiana Utility Regulatory Commission. On behalf of Citizens Action Coalition of Indiana. June 1995.

In Re Indianapolis Power and Light Cause No.39938. Written testimony on rate base, rate of return, and estimation of plant value. Before the Indiana Utility Regulatory Commission. On behalf of Citizens Action Coalition of Indiana. April 1995.

Petition of PSI Energy, Inc. for Authority to Raise Rates Cause 39584 Written testimony on utility incentive programs. Before the Indiana Utility Regulatory Commission. On behalf of Citizens Action Coalition of Indiana. July 1994.

In Re Kauai Electric Division Docket No. 94-0097. Written testimony on utility rate design, and low-income and conservation programs. Before the Hawaii Public Utility Commission. On behalf of the Legal Aid Society of Hawaii. March 1995.

Economic Development and Incentive Tariffs Rulemaking Supplemental comments on the efficacy and design of economic development tariffs. Before the Public Utility Commission of Texas Project No. 11434. On behalf of the Texas Ratepayers' Organization to Save Energy. January 1994.

In Re Request for Increased Rates for Denver Water Comment and Exhibits on Late Payment Fees, Low-income conservation programs, Rate Design and Rate Shock. Prepared on behalf of ACORN. January 1994.

Economic Development and Incentive Tariffs Rulemaking
Prepared comments on the efficacy and design of economic development tariffs. Before the Public Utility Commission of Texas Project No. 11434. On behalf of the Texas Ratepayers' Organization to Save Energy. May 1993.

In the Matter of the Application of MAUI ELECTRIC COMPANY, LTD. for Approval of Rate Increases and Revised Rate Schedules and Rules. Written testimony on the issues of conservation, low-income rate design, late payment charges and rate shock. Before the Hawaii Public Utilities Commission Docket No. 7000 on behalf of Legal Aid Society of Hawaii. November 1992.

Petition of PSI Energy, Inc. for Approval of its Phase Environmental Compliance Plan... Prepared written testimony on the utility's proposed incentive plans and allowance banking proposal. Before the Indiana Utility Regulatory Commission, Cause No. 39346. On behalf of the Citizens Action Coalition of Indiana. September 1992.

Comments: In the Matter of the Application of Randy Heller for a Major Partition and Variance in the Rural Residential-5 Zone. Written comments on zoning issues. Before the Columbia County, Oregon Board of Commissioners on behalf of the Scappoose-Spitzenberg CPAC. May 1991.

In the Matter of the Investigation into the Portland Extended Area Service Region Docket UM-261.
Supplemental written testimony on the issues of rate design and cross subsidization. Before the Oregon Public Utility Commission on behalf of the Citizens' Utility Board of Oregon. February 1991.

In the Matter of: An Adjustment of Gas and Electric Rates of Louisville Gas and Electric Company. Case No. 90-158. Prepared written testimony on the issues of rate design, cost of service, and residential conservation programs. Before the Kentucky Public Service Commission on behalf of the Attorney General of Kentucky. November 1990.

In the Matter of the Investigation into the Portland Extended Area Service Region. Docket UM-261. Prepared written testimony on the issues of rate design, cost of service, and cross-subsidization. Before the Oregon Public Utility Commission on behalf of the Citizens' Utility Board of Oregon. October 1990.

In the Matter of: Rate Adjustment of the Western Kentucky Gas Company. Case No. 90-013. Prepared written testimony on the issues of rate design, cost of service, and residential conservation programs. Before the Kentucky Public Service Commission on behalf of the Attorney General of Kentucky. May 1990.

In the Matter of: Notice of Adjustment of Rates of Kentucky-American Water Company. Case No. 89-348. Prepared written testimony on the issues of rate design, cost of service, rates charges for public fire hydrants, and residential conservation. Before the Kentucky Public Service Commission on behalf of the Lexington-Fayette Urban County Government and the Office of the Attorney General of Kentucky. March 1990.

In the Matter of the Investigation into the Revenue Requirements and Rate Spread of Pacific Northwest Bell Telephone Company, d/b/a US West Communications, Inc. Docket UT-85. Direct written testimony on telecommunications rate design. Before the Oregon Public Utility Commission on behalf of the Citizen's Utility Board of Oregon. May 1989.

IN RE: City of Sheldon v. Iowa Public Service Company. Docket NO. SPU-88-7. Petition of the City of Sheldon for a certificate to establish a municipal electric utility. Expert written testimony on valuation principles and associated regulatory issues. Before the Iowa Utility Regulatory Board. On behalf of the City of Sheldon. March 1989.

In the Matter of the Investigation of Cost-of-Service Studies and the Rate design of ALASCOM, Inc. Docket U-87-25. Expert written testimony on intrastate toll rate design and issues relating to the provision of telecommunication services for the hearing impaired. Before the Alaska Public Utilities Commission. On behalf of the Alaska Consumer Advocacy Program. February 1989.

IN RE: Docket No. DPU 86-36. Investigation into the Pricing and Ratemaking Treatment to be Afforded New Electric Generating Facilities Which Are Not Qualifying Facilities. Expert written testimony on the regulatory treatment of conservation and demand side management programs. Before the Massachusetts Department of Public Utilities, on behalf of the Hampshire Community Action Commission (National Consumer Law Center). June 1988.

IN RE: Docket No. DPU 87-280. Western Massachusetts Electric Company. Expert written testimony on the cost effectiveness and economic justification of certain demand side management pilot programs. Before the Massachusetts Department of Public Utilities, on behalf of the Hampshire Community Action Commission (National Consumer Law Center) March 1988.

IN RE: Public Service Corporation of Indiana. Cause 37414 (Application to reduce rates). Expert written testimony on the issue of whether PSI's Marble Hill-related financial emergency continued, and whether PSI should be allowed to temporarily reduce rates via certain changes in accumulated tax accounting. Before the Indiana Utility Regulatory Commission, on behalf of the Citizens Action Coalition and the City of Terre Haute. April 1988.

IN RE: Public Service Corporation of Indiana. Cause 37414-S1 (Investigation to determine whether existing rates ought to be reduced). Prepared written testimony on the issue of the financial condition of PSI. Before the Indiana Utility Regulatory Commission on behalf of the Citizens Action Coalition and the City of Terre Haute. April 1988.

IN RE: New York State Electric and Gas Corporation. Cases 29541 and 29542. Expert written testimony on cost allocation and "economic development" rates. Before the Public Service Commission of the State of New York. July 1987. On behalf of the Public Utility Law Project. Albany, New York.

IN RE: Petition of CAC, City of Terre Haute, et al for a Reduction in the Retail Electric Rates of Public Service Company of Indiana. Cause No. 38411 Affidavit dealing with excess earnings. October 1987.

IN RE: Application of IBP, Inc. for a Water Withdrawal Permit for its Proposed Manchester Plant. Draft Water Use Permit No. 14,808. "Comments on the Public Health Impacts of Radium Contamination in the Jordan Aquifer." Before the Iowa State Department of Natural Resources. September 1987. On behalf of a coalition of local farmers and environmentalists.

IN RE: Western Massachusetts Electric Company. Docket No. D.P.U. 86-280. Expert written testimony on the economics of conservation investments targeted to low income and 'bad debt' customer subgroups. Before the Massachusetts Department of Public Utilities. March 1987. On behalf of the Hampshire Community Action Commission (National Consumer Law Center).

IN RE: Iowa Gas Company Request for Increased Rates. Docket No. RPU-85-22. Expert written testimony on rate design, interruptible rates for industrial users, and the allocation of franchise/user fee expenses. Before the Iowa State Commerce Commission. January 1986. On behalf of the City of Des Moines.

IN RE: Proposal to Set Maximum Rates Small Loan Companies Are Allowed to Charge Pursuant to Iowa Code Section 536.13.1(B) and 536.13(2). Docket No. ARC 5900. Before the Iowa State Banking Board. Written testimony opposing the proposal to increase the maximum rates to 36% per annum. October 1985. On behalf of the Iowa City Ratepayers Association.

IN RE: Union Electric Company Request for Increased Rates. Docket No. RPU-85-9. Expert written testimony on the question of whether the Callaway Nuclear Facility was a cost effective source of power to Iowa, and analyzing the impact of the proposed rates on economic development in Iowa. Before the Iowa State Commerce Commission. July 1985. On behalf of the Cities of Keokuk and Ft. Madison and Lee County, Iowa.

IN THE MATTER OF: Application of Duke Power Company for Approval of a General Increase in Electric Rates and Charges. Docket No. 85-78-E. Technical appendices in support of the expert written testimony of David E. Osterberg. Before the South Carolina Public Service Commission. July 1985. On behalf of the Consumer Advocate of the State of South Carolina.

IN RE: Rules Regarding Permissible Additional Charges for Involuntary Unemployment Insurance Premiums. Docket No. ARC 5249. Before the Administrator of the Iowa Consumer Credit Code. Written testimony on the impact of this type of insurance on consumers. February 1985.

IN THE MATTER OF: Union Electric Company. Docket No. 84-0109. Expert written testimony comparing the cost of power from Callaway Nuclear Station to other sources of power; utility planning; and the treatment of excessive costs. Before the Illinois State Commerce Commission. September 1984. For the Governor's Office of Consumer Services (Illinois).

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation: Case Nos. 28798, 28799, 28800. Before the Public Service Commission of the State of New York. Expert written testimony on the disposition of the savings from the availability of federal hydroelectric power on the Niagara-Mohawk system. September 1984. For the Public Utility Law Project (New York).

IN RE: Northwestern Bell Telephone Company. Docket No. RPU-84-7. Expert written testimony on discriminatory allocation of costs, cost causation, and the jurisdictional treatment of jurisdictionally unnecessary costs. Before the Iowa State Commerce Commission. June 1984. For the coalition for Fair utility Rates and the ISU Government of the Student Body.

IN RE: Wisconsin Power and Light Company. Docket No. 6680-UR-14. Expert written testimony on rate of return. June 1984. Before the Wisconsin Public Utilities Commission. For the Citizens Utility Board.

IN RE: Young Radiator. NPDES Permit 04-07-1-02. Report submitted on the sufficiency of the terms of the proposed permit. Before the Iowa Department of Water, Air and Waste Management. April 1984. For: Local Citizens, Centerville, Iowa.

IN RE: Peoples Natural Gas Company, Division of InterNorth Inc. Docket No. RPU-83-20. Expert written testimony on conservation funding and the regulatory treatment of excess capacity. Before the Iowa State Commerce Commission. October 1983. For the Iowa Ratepayers Association.

IN RE: Iowa Electric Light and Power Company. Docket No. RUP-83-23 (TF-83-264). Expert written testimony on utility planning and excess capacity. Before the Iowa State Commerce Commission. September 1983. For the Iowa Ratepayers Association.

IN RE: Iowa-Illinois Gas and Electric Company. Docket No. RPU-83-22. Supplemental written testimony on the issue of the prudence of company management. Before the Iowa State Commerce Commission. October 1983. For the Iowa Ratepayers Association.

Iowa Power and Light Company; Iowa Southern Utilities Company; and Iowa Illinois Gas and Electric Company. Docket No. RPU-82-39. Expert written testimony on the natural gas purchasing practices of the above listed utilities. Before the Iowa State Commerce Commission. September 1983. For the Iowa Ratepayers Association.

In the Matter of the Application of Otter Tail Power Company for Authority to Establish Increased Rates for Electric Service in South Dakota. Docket No. F-3418. Expert written testimony before the South Dakota Public Utilities Commission on the issue of rate design (the OSL Rate). July 1983. For the Citizens Organized for the Purpose of Equality (COPE), Sisseton, South Dakota.

IN RE: Petition for a Special Exception for the Construction of a High Voltage Transmission Line within Iowa City, Iowa. Expert written testimony on utility planning. Before the Iowa State Commerce Commission. November 1982. For the Iowa City Ratepayers Association.

Prepared written testimony in Docket No. FCU-82-5 before the Iowa Commerce Commission on the subject of the regulatory treatment of winter utility shutoffs. December 1982. Citizens/Labor Energy Coalition.

IN RE: Rate Making Treatment of Excess Electric Utility Generating Capacity. Docket No. RMU-82-4. Expert written testimony on rate making treatment of excess electric utility generating capacity. Before the Iowa State Commerce Commission. November 1982, p. 27. Community Action Research Group.

IN RE: Petition for Franchise of 4.2085 Miles of 72,000 Volt Transmission Line in Clayton County, Iowa. Docket No. E-19540. Supplementary written testimony on utility planning and forecasting. Before the Iowa State Commerce Commission. April 1982.

IN RE: Iowa Public Service Company. Docket No. RPU-81-8. Supplemental direct written testimony on rate of return, excess capacity and utility planning. Before the Iowa State Commerce Commission. September 1981, p. 14. Woodbury County Community Action Agency and Citizens/Labor Energy Coalition.

IN RE: Iowa-Illinois Gas and Electric Company. Docket No. RPU-81-5. Expert written testimony on utility planning and forecasting. Before the Iowa State Commerce Commission. September 1982. On behalf of Iowa Planners Network.

IN RE: Iowa Public Service Company. Docket No. RPU-81-8. Expert written testimony on rate of return and other issues. Before the Iowa State Commerce Commission. August 1981. On behalf of Woodbury County Community Action Agency and Citizens/Labor Energy Coalition.

IN RE: Iowa Power and Light Application for a Revision of Rates. Docket Nos. RPU-78-23 and RPU-80-36. Expert written testimony on rate design. Before the Iowa State Commerce Commission. February 1981. On behalf of the Citizens/Labor Energy Coalition.

IN RE: Iowa State Commerce Commission Rules Regarding Rates for Cogeneration and Small Power Production. Statement of David Osterberg and Michael F. Sheehan on rates for Small Power Producers under Section 210 of the Public Utility Regulatory Policies Act of 1978. Before the Iowa State Commerce Commission. January 1981. On behalf of Continental Hydro Corporation.

IN RE: Iowa Electric Light and Power's Request for Authorization to Construct a 650 MW Coal-fired Generating Plant at Panora, Iowa. Written testimony providing a critique of certain aspects of the applicant's demand forecasting methodology (with David Osterberg). Before the Iowa State Commerce Commission. November 1980.

IN RE: Rules Requiring the Filing of Certain "Cost-of-Service" Information with the Iowa State Commerce Commission. Written testimony evaluating the Rules proposed by Commission Staff. RMU-80-1. Before the Iowa State Commerce Commission. Legal Services and Citizens/Labor Energy Coalition.

IN RE: Rate Increase Request by Iowa Power and Light. Written testimony evaluating: 1) the economic rationale for special rates for certain electric appliances; 2) the justification for proposed changes in customer charges; and 3) various alternative block rates. Before the Iowa State Commerce Commission. March 1981.

**Service on
Government
Commissions &
Committees:**

Columbia County Solid Waste Advisory Committee. 1998-Present. Columbia County, Oregon.

Conservation Acquisition Council, Columbia River People's Utility District (Columbia County, Oregon). 1992-6.

AT&T Consumer Advisory Panel (1990-1995)

Research Advisory Committee, National Regulatory Research Institute, Ohio State University, Columbia, Ohio. 1990-1993.

Citizen Planning Advisory Commission, Columbia County, Oregon 1990-Present

Rate Advisory Committee, Columbia River Peoples' Utility District (Columbia County, Oregon). 1990-6.

Community Energy Management Advisory Board, Energy Policy Council (State of Iowa) 1984-87.

Iowa City, Iowa: City Franchise Commission (1983-4).

Recent Studies:

BOLI's Treatment of Laborer, Truck Driver and Carpenter Classifications in its 1999 Prevailing Wage Determination
Prepared for the Fair Contracting Foundation, Portland, OR.
April 1999.

Method for Calculating Gross Value of a Sand and gravel Deposit in the Ground Draft March 1999

Principles for Valuing a Municipal Distribution Utility in 1998 May 1998.

Home-Based Enterprise in Oregon: Improving Local Regulation of an Important Economic Asset September 1996.

An Investigation into the Elements of Regulatory Success and Failure: Ten Studies Prepared on behalf of METRO (the three county planning agency for the Portland, Oregon region). 1997.

Fair Housing Plan: Analysis of Impediments and Strategies to Address Them (With Roger Colton) August 1996. On behalf of Washington County and the City of Beaverton, Oregon.

Lone Star's Plan to Strip Mine Columbia County Formal economic study presented to the Columbia County Planning Commission in **In Re Applications PA 4-96, 5-96, 6-96** for map amendments and zone changes from agriculture and industry to surface mining. On behalf of the Scappoose-Spitzenberg CPAC. November 1996.

In the Matter of the Application of WEBCO for Approval of the Preliminary Plat for the Brookfield Subdivision Before the City of St. Helens, Oregon. Study presented on behalf of the Friends of Good Planning. November 1996.

The Comparative Economics of Nebraska Revised Statutes §70-1010 A study dealing with the statutory standard for compensating rural electric providers when municipal electric utilities expand to keep pace with urban growth. Presented to the Natural Resources Committee of the Nebraska Legislature. October 1996.

Home-Based Enterprise in Oregon: Improving Local Regulation of an Important Economic Asset Winner of the Cascade Policy Institute's 1996 Oregon Better Government Competition. September 1996.

Fiscal Stability and Risk Management Over Time: Planning for Reasonable Fund Balances and Reserves January 1996.

County Sponsored Water Districts to Facilitate the Construction of High Density Rural Subdivisions: An Evaluation Presented to the Columbia County Board of Commissioners on behalf of the Scappoose-Spitzenberg CPAC. November 1995.

Fair Market Value for the Franchise: Law and Economics of Franchise Renewal in Louisville On behalf of the Legal Aid Society of Louisville, KY. March 1995.

Transfer Stations, Curbside Haulers, Landfills: Survey of Costs June 1996.

Comparison of Regulatory Standards for Rate Regulation of Transfer Station Franchisees December 1995

Environment and Jobs: The Employment Impacts of Federal Environmental Investments National Commission for Employment Policy: Washington, D.C., April 1995. Research Report No. 95-02. With Skip Laitner, Marshall Goldberg, and Marc Baldwin.

Growing Cities: Valuation and Compensation Issues in Dealing With Rural Electric Co-ops, Prepared on behalf of the American Public Power Association. (With Roger Colton and Richard Cvarak) August 1995.

An Assessment of Low-Income Energy Needs in Washington State Prepared on behalf of the Washington State Department of Community Development. November 1993. pp.319. (With Roger Colton, Skip Laitner, Adrienne Quinn, Scott Foster, and Gregory Holmes).

Economic Development Utility Rates: Targeting, Justifying, Enforcing November 1993 (With Roger Colton).

Environmental Site Assessment: Leasehold Site for New Library, Government Block, Scappoose, Oregon Prepared on behalf of the Scappoose Public Library District. October 1993.

Of Sunflowers and Dandelions: A Comparative Analysis of Low-Income Rate Discounts May 1993.

Affordable Housing and Section 8 Utility Allowances: An Evaluation and a Proposal for Action. Part I: Adequacy of Annual Allowances March 1993 (With Roger Colton).

Affordable Housing and Section 8 Utility Allowances: An Evaluation and a Proposal for Action. Part II: Adequacy of Monthly Allowances March 1993 (With Roger Colton).

Affordable Housing and Section 8 Utility Allowances: An Evaluation and a Proposal for Action. Part III: Individualized Relief March 1993 (With Roger Colton).

Major Telecommunications Problems for Consumers: An Agenda for Consumer Advocates Prepared for TURN. November 1992.

Valuation and Compensation Issues in Establishing a Municipal Electric Operation: A Manual for Professional Staff Prepared for the American Public Power Association (Draft: May 1992).

Financial Plan and Review of Options Prepared on behalf of the Scappoose (Oregon) Public Library District. April 1992.

Externalities and Least Cost Planning in Wisconsin: The Question of Job Impacts Prepared for Economic Research Associates, Eugene, Oregon. March 1992.

The Impact of the Clean Air Act Amendments of 1990 on Missouri Prepared for Economic Research Associates, Eugene, Oregon. September 1991.

Energy Efficiency, Economic Development and the Funding Problem Prepared for Economic Research Associates, Eugene, Oregon. November 1991.

Energy and Economic Development: Tuning Agency Powers to New Opportunities Prepared for Economic Research Associates, Eugene, Oregon, 1991.

A Preliminary Assessment of the Local Economic and Fiscal Impacts of a National Forest in Southern Iowa Prepared for the Iowa Natural Heritage Foundation, January 1990. (With David Osterberg, Skip Laitner, and Peter Fisher).

An Analysis of the Finances of the State of Iowa. Prepared for the Iowa United Professionals. February 1991.

Low-Income Weatherization as a Stimulus to Economic Development in Washington. Prepared for the Washington State Department of Community Development. January 1991 (With Skip Laitner).

The Economics of Energy Efficiency Building Codes for Cities With Municipally Owned Utilities Prepared under contract to Economic Research Associates, Eugene, Oregon. August 1990.

Elements of a Standard Minimum Program for Low Income Ratepayers in Utility Rate Cases. A discussion paper for general circulation. May 1990.

Incentive Rates for Large Manufacturing Concerns: A Review and a Proposal. Prepared for the Texas Department of Agriculture. November 1989.

Regional Citizen Advisory Groups to Multistate Utility Holding Companies: A Public Interest Review. Prepared as part of a Michigan Divestiture Review Fund study of the pros and cons of an Ameritech Citizen Advisory Group. March 1989.

Making Allies of Law, Labor and the Environment: An Exposition for Labor Lawyers. Prepared for the Lawyers Coordinating Committee of the AFL-CIO. (With Matthew Glasson and Peggy Hillman). May 1989.

Issues in Demand-Side Management. Prepared for the Department of Public Service, State of Vermont. February 1989.

The Problem of Mass Evictions in Mobilehome Parks Subject to Conversion. Prepared for Oregon Legal Services for presentation to the City Council of the City of Forest Grove, Oregon. February, 1989.

The Monopolies' Campaign to Fleece POTS: Can Plain Old Telephone Service Be Saved?: Some Recommendations. Prepared for the Citizens Action Coalition of Indiana. October 1988.

An Analysis of Davenport City Finances (Revised). Prepared for the Davenport Association of Professional Firefighters, for presentation to an Iowa Public Employment Relations Board arbitrator. Davenport: September, 1988.

An Analysis of Davenport City Finances (Revised). Prepared for the Union of Professional Police, for presentation to an Iowa Public Employment Relations Board arbitrator. Davenport: September, 1988.

The Problem of Political and Administrative Corruption in State Economic Development Programs. Prepared for the Association for Ethical Government. July 1988.

Of Ratebases, Subscriber Line Charges, and Other Strange Beasts: The Public Interest Economist as Ms. Goodwrench in Energy/Utility Litigation. Prepared for the National Consumer Law Center for presentation to the NLADA Conference, Berkeley, California. July 1988.

An Analysis of Davenport City Finances. Prepared for the Davenport Association of Professional Firefighters, for presentation to an Iowa Public Employment Relations Board factfinder. Davenport: June, 1988.

An Analysis of Davenport City Finances. Prepared for the Union of Professional Police, for presentation to an Iowa Public Employment Relations Board factfinder. Davenport: June, 1988.

Economic Vitality for Iowa: A Choice of Programs and Philosophies. Prepared for the Alamakee County Almanac: May 1988. (With David Osterberg).

The Monopolization of the Meatpacking Industry: Tactics and Results, 1978-1983. (With David Osterberg). Fall 1987-Spring 1988.

The Iowa Department of Transportation RISE Grant to the City of Manchester/Manchester Enterprises, Inc.: A Case of Official Misconduct. A Complaint to the Iowa Attorney General. (66 pages) July 1987.

Francis Lauer Youth Services, Cerro Gordo County, Iowa. An Analysis in Support of the Transition From Cerro Gordo County Agency to Non-Profit Corporation. Presented to the Cerro Gordo County Board of Supervisors on Behalf of Francis Lauer Youth Services. (52 pages). July 1987.

Predatory Competition, Jobs, and the Supply of Hogs: The Role of State Assistance in the Collapse of the Independent Hog Packing Industry in Iowa. Presented to the Iowa Transportation Commission. May 1987.

Combining Fire and Ambulance Service to Improve Service and Lower Cost. Prepared for the Davenport Association of Professional Firefighters (Local 17, International Association of Firefighters). March 1987.

Of Market Rates and Indubitable Equivalents: Law and Economics in Determining the Appropriate Interest Rate in Farm Chapter 11 Cramdowns. January 1987. 80pp. (With Roger Colton).

Researching the American Corporation: Purposes and Methods. January 1987. 50pp.

Local Regulation of Utilities in Nebraska: A Guide for Local Officials. Prepared for the Nebraska State Energy Office. Lincoln, Nebraska. December 1986. 150pp.

A Comparison of Base Wages Plus Fringe Benefits at Various Plants (in the meatpacking industry). Prepared for the United Food and Commercial Workers Local 222. November 1986.

Public/Private Enterprise as an Economic Development Strategy for States and Cities Prepared for the Economic Development Administration of the U.S. Department of Commerce. July 1986. (With Peter S. Fisher and Roger Colton).

Evaluation of the Energy Management Technician Pilot Program, Prepared for the Iowa State Energy Policy Council. June 1986.

The Future of Pork Packing in Monmouth, Prepared for the City of Monmouth, Illinois, and the Illinois Development Finance Authority. June 1986.

An Analysis of Davenport City Finances (Revised) Prepared for the Iowa State Policemen's Association, Local #2. April 28, 1986.

An Analysis of Davenport City Finances (Revised), Prepared for the International Association of Firefighters, Local 17. April 18, 1986.

The Des Moines-ICA Sewage Treatment Facilities Plan: The Economic Ramifications of a 1991 Completion Date Prepared for the City of Des Moines for presentation to the U.S. Environmental Protection Agency. April 1986.

Municipal Regulation of Cable TV Holding Companies After the Cable Communications Policy Act of 1984: (Heritage Corporation and the Siege of Block 80) Prepared for the Iowa City Ratepayers Association. April 1986.

An Analysis of Davenport City Finances. Prepared for the International Association of Firefighters, Local 17. February 1986.

An Analysis of Davenport City Finances: Preliminary Report. Prepared for the Iowa State Policemen's Association, Local #2. February 1986.

An Analysis of the Finances of the City of Council Bluffs. Prepared for the Fraternal Order of Police, Council Bluffs Lodge #1. January 1986.

Telephones for People: Providing for the Old, the Young, the Rich, the Poor, the Middle, Business and Workers, Cityfolks and Farmfolks. Minority Report of Six Members of Northwest Bell Citizens Council #2. October, 1985.

Thinking About Inter-Class Telephone Subsidies: (The Tale of the Gardener's Pay). Prepared for the Iowa Ratepayers Association. April 1985.

The Great Gumdrops Monopoly: A Parable. Prepared for Northwest Bell Citizen Council #2, April 1985.

Universal Service: Materials for Discussion. Prepared for Northwest Bell Citizen Council #2, April 1985.

The Economic Impacts of a Prevailing Wage Law for Iowa State Construction Projects. Prepared for the Iowa State Building and Construction Trades Council. February 27, 1985. (with Peter S. Fisher).

A Primer on Bypass. Prepared for Northwest Bell Citizen Council #1, January 1985.

Materials on Telephone Rates: The Consumer Position. Prepared as Part I of a manual on telephone regulation for consumer groups. January 1985.

An Analysis of Davenport City Finances: A Preliminary Report. Prepared for the Iowa State Policemen's Association Local 2. January 1985.

Combining Fire and Ambulance Service. Prepared for the City of Rock Island on behalf of the Rock Island Firefighters Local 26. October 1984.

Designing Electric Rates to Conserve Community Resources, Enhance Local Productivity and Stem the Outward Flow of Energy Dollars: The OSL Rate Design Proposal for Nebraska. Prepared for the Nebraska Energy Office. (With Skip Laitner). October 1984.

An Analysis of City Finances: Burlington, Iowa. Prepared for Local 301 International Association of Firefighters. March 1984.

An Analysis of Dubuque City Finances. Prepared for the Operating Engineers. March 1984.

An Analysis of City Finances: Burlington, Iowa. Prepared for Local 828. The American Federation of State, County and Municipal Employees. March 1984. With Peter Fisher.

Source Reduction in Hazardous Materials Regulation: A Strategy for Both Economic Development and the Environment. Prepared for the Select Advisory Panel on Hazardous Waste Management of the Iowa Department of Water, Air, and Waste Management. February 1984.

The Electric Ratepayers Protection Act: An Evaluation. Prepared for and presented to the Consumer Protection Committee of the Missouri Legislature. January 1984.

Investments in Energy Engineering and Technology at the Local Level: Planning an Assist from State Agencies. Prepared for the Nebraska Energy Office, February 1984.

The Impact of Increasing Concentration in the Meatpacking Industry on Iowa's Livestock Producers and Communities. Prepared for *Reports on the Iowa Economy*. June 1983.

Policy Options for Dealing with the Impact of Continuing Energy Price Increases on the Iowa Economy for the Iowa State Legislature. February 1983 (LEAG).

An Analysis of Proposals for the Reform of the Iowa Tax System (with Peter S. Fisher). December 1982.

Reforming Iowa's Individual Income Tax to More Fully Account for Tax Shelters (with Peter S. Fisher). October 1982.

The Iowa City Electric Franchise: A Report to the City Manager. January 1982.

A Comparison of Major Cities in Iowa and Surrounding States by Income, Wage Levels, and Housing and Food Costs. March 1983.

IBP at Stanwood: Estimating the Regional Impact. February 1983.

A Program of Progressive Tax Policies for the State of Iowa (with Peter S. Fisher). February 1982.

Municipal and Cooperative Operation of Branch Railroad Lines in Iowa: Two Alternatives to Abandonment For the Iowa State Legislature (Peter Fisher and Michael Sheehan). December 1980.

Book Reviews:

Review of Walter Adams and James W. Brock, *Antitrust Economics on Trial: A Dialogue on the New Laissez Faire*, In *The Journal of Economic Issues* (December 1992).

Review of James A. Gross, *Teachers on Trial: Values, Standards & Equity in Judging Conduct and Competence*. In *The Journal of Labor Studies*. Summer 1990.

Review of Ronald M. Green and Richard J. Reibstein, *Negligent Hiring: Fraud, Defamation, and Other Emerging Areas of Employer Liability*. In *The Journal of Labor Studies*. Fall 1989.

Review of Lawrence E. Rothstein, *Plant Closings: Power, Politics, and Workers*, in *The Journal of Economic Issues*. March 1988.

Review of John Munkirs, *The Transformation of American Capitalism: From Competitive Market Structure to Centralized Private Sector Planning*, in *The Journal of Economic Issues*, March 1986.

Review of Claes Brudenius and Mats Lundahl, *Development Strategies and Basic Needs in Latin America*, in *The Annals of Regional Science*, July 1985.

Review of Samuel P. Epstein, et al., *Hazardous Wastes in America*, in *The Environmental Professional*, V.6, #1. 1984.

David Morell and Christopher Magorian, *Sitting Hazardous Waste Facilities: Local Opposition and the Myth of Preemption*, in *The Environmental Professional*, V.5, #3/4. 1983.

Staughton Lynd, *The Fight Against Shutdowns: Youngstown's Steel Mill Closings*, in *The Journal of Economic Issues*, September 1984.

Michael S. Baram, *Alternatives to Regulation: Managing Risks to Health, Safety and the Environment*, in *The Environmental Professional*, V.5, #3/4. 1983.

Richard A. Berk, et al., *Lessons in Conservation from the Great California Drought*, in *The Water Resources Bulletin*. October 1983.

Review of Lawrence B. Lee, *Reclaiming the American West: A Historiography and Guide*, in *The Water Resources Bulletin*, V. 18, #4. August 1982.

Review of Mario Barrera, *Race and Class in the Southwest*, in *The Journal of Economic History*, V. 42, #2. June 1982.

Review of Robert D. Friedman, *Sensitive Populations and Environmental Standards*, in *The Environmental Professional*, V. 3, #3. 1982.

Review of E. Englebert's *California's Water Planning and Policy*, in *The Water Resources Bulletin*. October 1981.

Review of Charles T. Unseld, et al., eds., *Sociopolitical Effects of Energy Use and Policy*. Washington, D.C.: National Academy of Sciences, 1979, in *The Journal of Economic Issues*. December 1981.

Review of W. W. Robinson, *California Land*, In *The Journal of Economic History*. June 1980.

Review of Wm. C. Peters, *Exploration and Mining Geology*, in *The Journal of Energy and Development*. Autumn 1980.

Review of Burnham, P. Beckwith, *The Theory of Free or Communist Distribution*, in *The Social Science Journal*. January 1981.

Review of Russ Talbot, *The European Community's Regional Fund*, in *The Annals of Regional Science*. July 1980.

Review of Louis P. Cain, *Sanitation Strategy for a Lakefront Metropolis: The Case of Chicago* in *The Water Resources Bulletin*. April 1980.

Review of M. R. Goodall, et al., *California Water: A New Political Economy* in *The Water Resources Bulletin*. February 1980.

Review of Shabad and Mote, *Gateway to Siberian Resources: The Baikal-AMVR Mainline*, in *Growth and Change*. July 1979.

Review of N. Birnbaum, ed., *Beyond The Crisis, History of Political Economy*, in *History of Political Economy*, Vol. 11, No. 1. Spring 1979.

Review of *Mathematics of Environmental Processes*, in *Journal of Energy and Development*, Vol. 3, No. 2. Spring 1978.

Review of A. Zaubermann's, *The Mathematical Revolution of Soviet Economics*, in *History of Political Economy*, Vol. 8, No. 2. Summer 1976 (H. Sherman second author).

**Post Graduate
Courses:**

Oregon Land Use Law, OSB. Portland, Oregon December 1996.

Advanced Insurance Issues Facing Oregon Businesses. OSB Portland, Oregon September 1996.

National Park and Public Land Ecosystems: Meeting the Challenge of Common Boundaries and Conflicting Mandates. Sponsored by the Center for Environmental and Resource Law. Snowbird, Utah. April 1995. (Paper presented: "Whose Goals and Whose Alternatives? How Bad Can a Private Goal Be and Still Define the EIS Under NEPA?")

Federal Civil Litigation in Oregon, OSB. October 1994.

Economic Considerations in Managing Hazardous Waste, The Tenth Annual Hazardous Waste Law and Management Conference. Sponsored by the Northwestern School of Law. October 1993.

Spanish Language Refresher: 120 hours. El Centro Cultural. Hillsboro, Oregon. 1988-9. (Certificate).

Natural Gas Regulation Training Conference, National Consumer Law Center, Pittsburgh, Pennsylvania, November 1982.

Faculty Workshop Program on Breeder Reactor Technology, Argonne National Laboratory, Argonne-West, Idaho Falls, Idaho, August 2-5, 1982.

Workshop on Appraisal of Utilities and Railroad Property for Ad Valorem Taxation. National Tax Association -- Tax Institute of America. Wichita State University, July 27-30, 1981. (Certificate)

Simulation Modeling and Analysis. Institute for Professional Education. Los Angeles, September 1978. (Certificate)

Employment History: Current: Managing Partner: Osterberg & Sheehan, Public Utility Economists, Scappoose, Oregon & Mount Vernon, Iowa.

Partner: Fisher, Sheehan and Colton, Public Finance and General Economics, Scappoose, Oregon, Iowa City, Iowa, and Belmont, MA.

Private practice of law.

1989-92 Counsel, Telecommunications Law Project, Citizens' Utility Board of Oregon, Portland, Oregon.

1979-84 Assistant Professor, Graduate Program in Urban and Regional Planning; and Research Associate at the Institute of Urban and Regional Research, The University of Iowa, Iowa City, Iowa 52242.

1979 Lecturer, Graduate School of Administration, UCR, (Analysis of Projects). (Winter)

1976-9 Lecturer, Department of Economics, California State College at San Bernardino.

1978 Consultant, Richard Terry & Associates, *Impact of Federal Sewer Sizing Limitations on Economic Growth in the West San Bernardino Valley.*

1977-8 Research Associate, UCR-USDA (Forest Fire Damage Functions).

1977 Water Resource Consultant, Janczyk & Sheehan, Riverside (water quality problems in the Santa Ana and San Jacinto watersheds).

1976-7 Holder of a Regent's Fellowship, UCR.

Spr 1976 Research Assistant (Geothermal Development Project), Department of Economics, UCR.

1976 Teaching Assistant (Microeconomics), Department of Economics, UCR). (Fall, Winter)

Spr 1975	Research Assistant to Professor K. C. Kogiku in applied mathematical economics.
1975	Holder of a Regent's Fellowship. (Fall, Winter)
1975	Associate-in-Economics, Department of Economics, UCR (to teach one course in labor economics). (Winter)
1974-76	Instructor, Chapman College (Microeconomics, Macroeconomics, Statistics, Development, Comparative Systems, Cycles and Growth, Urban Economics, Decision Theory, Quantitative Methods, and Operations Research).
1974	Consultant, A. A. Webb Associates, Inc., Consulting Engineers, Riverside (urban information systems).
1973-4	Teaching Assistant (Economic Statistics), Department of Economics, UCR.
1970-2	Dean's Statistical Clerk, Dean James Earley, College of Social and Behavioral Science, UCR.
1969-70	Assistant to the Hospital Administrator, Patton State Hospital.
1967-69	Electrician, Timna Copper Mines.
1963-66	U.S. Marine Corps.

Honors and Awards: Winner, Cascade Policy Institute Better Government Competition 1996 for the study, *Home-Based Enterprise in Oregon: Improving Local Regulation of an Important Economic Asset* September 1996.

Fullbright Fellowship to Pakistan for 1979-81 awarded August 1979 (declined).

Affiliations:

Association for Evolutionary Economics
Association for Institutional Thought
Lawyers Coordinating Committee, AFL/CIO
Oregon Bar Association
Policy Studies Association

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SUMMARY

I have worked for twenty-four years as a consultant and attorney on complex management, engineering, and economic issues, primarily in the field of energy. This work has involved conducting technical investigations, preparing technical analyses, presenting expert testimony, providing support during all phases of litigation, and advising clients during settlement negotiations. I have received undergraduate and advanced engineering degrees from the Massachusetts Institute of Technology and Stanford University and a law degree from Stanford Law School

PROFESSIONAL EXPERIENCE

Failure Analysis - Evaluated the causes of power plant and system outages, equipment failures, and component degradation, determined whether these problems could have been anticipated and avoided, and assessed liability for repair and replacement costs.

Management Assessment - Assessed whether management fully disclosed potential risks to investors. Investigated whether management fully disclosed or withheld material facts from regulators. Evaluated whether large construction projects totaling more than \$40 billion were prudently designed and constructed. Investigated more than one hundred nuclear power plant outages to determine if they were caused or extended as the result of imprudent management. Evaluated management responses to equipment and component failures. Assessed the adequacy of utility quality assurance and maintenance programs. Examined the selection and supervision of contractors and subcontractors. Evaluated the reasonableness of contract provisions and terms in proposed power supply agreements.

System Operations and Reliability Analysis - Evaluated the planning for new utility generating and transmission facilities totaling over \$10 billion. Evaluated whether new utility generating and transmission additions were needed to ensure adequate system reliability. Examined utility off-system capacity purchases. Explored the opportunities for off-system sales by electric utilities. Evaluated whether there was excess generating capacity on electric utility systems.

Economic Analysis -. Quantified the economic consequences of management imprudence. Evaluated purchased power availability and cost. Prepared continued operation versus retirement economic analyses for major electric generating facilities.

Electric Industry Restructuring and Deregulation - Presented and published papers on the potential impact of electric industry restructuring and economic deregulation on nuclear power plant safety. Assisted clients in quantifying stranded plant costs. Explored the potential impact on utility maintenance programs of the adoption of performance-

based regulation. Evaluated the technical and economic risks of proposed corporate acquisitions by clients.

Expert Testimony - Presented the results of management, technical and economic analyses as testimony in more than fifty proceedings before regulatory boards and commissions in eighteen states, before two federal regulatory agencies, and in state and federal court proceedings.

Litigation Support - Participated in all aspects of the development and preparation of case presentations on complex management, technical, and economic issues. Assisted in the preparation and conduct of pre-trial discovery and depositions. Helped identify and prepare expert witnesses. Aided the preparation of pre-hearing motions and post-hearing briefs and appeals. Assisted counsel in preparing for hearings and oral arguments. Advised counsel during settlement negotiations.

REPRESENTATIVE SIGNIFICANT ACHIEVEMENTS

Evaluated the prudence of Niagara Mohawk Power Corporation's management of construction of the Nine Mile Point Unit No. 2 Nuclear Station. Presented testimony that formed the basis for a decision by the New York State Public Service Commission that \$300 million of the cost of the unit should be permanently excluded from rates.

Analyzed whether a new coal-fired generating unit represented excess capacity on the Northern Indiana Public Service Company system. Presented testimony that led to a finding by the Indiana Public Service Commission that the new unit was not used and useful and, consequently, that a four year phase-in of the utility's investment in the plant was appropriate. This resulted in a permanent savings for consumers of more than \$65 million.

Investigated the prudence of Southwest Gas Corporation's plastic and steel pipe repair and replacement programs. The results of this investigation formed the basis for a settlement by the staff of the Arizona Corporation Commission and the utility that shared pipe repair and replacement costs between ratepayers and shareholders.

Evaluated whether outages of the Wolf Creek Nuclear Plant had been caused or extended by utility mismanagement. Presented testimony that formed the sole basis for a finding by the Kansas Corporate Commission that the utility should bear \$6.9 million of replacement power costs incurred during the outages.

Investigated whether outages of the three units at the Palo Verde Nuclear Generating Station were caused or extended by management imprudence. The results of this investigation formed the basis for a settlement by the staff of the California Public Utilities Commission and the Southern California Edison Company that shared outage-related costs between ratepayers and shareholders.

Evaluated whether Northeast Utilities had prudently managed the 1992/1993 replacement of the steam generators at Millstone Unit No. 2.

Assisted clients in evaluating the technical and economics risks associated with purchasing majority ownership in an electric utility company that was a minority owner of the Seabrook Nuclear Station.

CLIENTS

Regulatory Commissions in Arkansas, Arizona, California, Kansas and Maine; municipal utilities in Massachusetts, North Carolina, New York and Texas; state attorneys general in five states; state consumer counsels or public advocates in twelve states; independent power producers; law firms; investment firms; shareholders of investor-owned utilities; municipalities and counties in four states; the majority owners of the Great Bay Power Company; elected officials in two states; citizen utility boards in Illinois and Wisconsin; the Associated Industries of Massachusetts; and the Environmental Law and Policy Center of the Midwest.

WORK HISTORY

1994 - Present: President, Schlissel Technical Consulting, Inc.

1983 - 1994: Director, Schlissel Engineering Associates

1979 - 1983: Private Legal and Consulting Practice

1975 - 1979: Attorney, New York State Consumer Protection Board

1973 - 1975: Staff Attorney, Georgia Power Project

EDUCATION

1983-1985: Massachusetts Institute of Technology
Special Graduate Student in Nuclear Engineering and Project Management,

1973: Stanford Law School
Juris Doctor

1969: Stanford University
Master of Science in Astronautical Engineering,

1968: Massachusetts Institute of Technology
Bachelor of Science in Astronautical Engineering,

PROFESSIONAL MEMBERSHIPS

- * New York State Bar since 1981
- * The Federal Bar since 1975
- * American Nuclear Society
- * National Association of Corrosion Engineers
- * National Academy of Forensic Engineers (Correspondent Affiliate)

ATTACHMENT 1

TESTIMONY

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
Maryland Public Service Commission	8795	Maryland Office of People's Counsel	December 1998	Future operating performance of Delmarva Power Company's nuclear units.
Maryland Public Service Commission	8794/8804	Maryland Office of People's Counsel	December 1998	Baltimore Gas and Electric Company's proposed replacement of the steam generators at the Calvert Cliffs Nuclear Power Plant. Future operating performance of nuclear units.
Indiana Utility Regulatory Commission	38702-FAC-40-SI	Citizens Action Coalition of Indiana and Indiana Consumers for Fair Utility Rates	November 1998	Whether the current outages of the two units at the D.C. Cook Nuclear Plant were caused or extended due to mismanagement.
Arkansas Public Service Commission	98-065-U	General Staff of the Arkansas Public Service Commission	October 1998	Results of investigation into Entergy's proposed replacement of the steam generators at the ANO Unit 2 Steam Generating Station.
Massachusetts Department of Telecommunications and Energy	97-120	Massachusetts Office of Attorney General	October 1998	Whether the recent outages of the three units at the Millstone Nuclear Station were caused or extended due to mismanagement. The appropriate Transition Charge for the Western Massachusetts Electric Company.
Connecticut Department of Public Utility Control	98-01-02	Connecticut Office of Consumer Counsel	September 1998	Review of nuclear operations, nuclear operating and capital costs, system reliability improvement costs, and other aspects of utility rate filing.
Illinois Commerce Commission	97-0015	Illinois Citizens Utility Board	May 1998	Whether any of the outages of the twelve Commonwealth Edison Company nuclear units during 1996 were caused or extended by management imprudence. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended unit outages could have been avoided or addressed prior to the outage. Quantification of outage-related fuel and replacement power costs.
Public Service Commission of West Virginia	97-1329-E-CN	Consumer Advocate Division of the Public Service Commission of West Virginia	March 1998	Whether a proposed 765 kV transmission line from Wyoming, West Virginia, to Cloverdale, Virginia is needed to enable the Appalachian Power Company to adequately and reliably serve the needs of customers in its Eastern/Southern service areas. Whether the proposed transmission line will enhance Appalachian Power Company's ability to make regional power transfers to support other utilities' system reliability needs.
Illinois Commerce Commission	97-0018	Illinois Citizens Utility Board	March 1998	Whether any of the outages of the Clinton Power Station during 1996 were caused or extended by management imprudence. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended plant outages could have been avoided or addressed prior to the outage. Quantification of outage-related fuel and replacement power costs.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
Connecticut Department of Public Utility Control	97-05-12	Connecticut Office of Consumer Counsel	October 1997	The costs associated with the current extended outages of the three units at the Millstone Nuclear Power Station.
New Jersey Board of Public Utilities	ER96030257	New Jersey Division of Ratepayer Advocate	August 1996	Calculation of replacement power costs.
Illinois Commerce Commission	95-0119	Illinois Citizens Utility Board	February 1996	Whether any of the outages of the twelve Commonwealth Edison Company nuclear units during 1994 were caused or extended by management imprudence. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended unit outages could have been avoided or addressed prior to the outage. Quantification of outage-related fuel and replacement power costs.
Public Utility Commission of Texas	13170	Texas Office of Public Utility Counsel	December 1994	Whether any of the outages of the River Bend Nuclear Station during the period October 1, 1991 through December 31, 1993 were caused or extended by management imprudence. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended plant outages could have been avoided or addressed prior to the outage. Quantification of outage-related fuel and replacement power costs.
Public Utility Commission of Texas	12820	Texas Office of Public Utility Counsel	October 1994	The Operations and Maintenance expenditures related to extended outages of the two units at the South Texas Nuclear Generating Station.
Wisconsin Public Service Commission	6630-CE-197 6630-CE-209	Wisconsin Citizen Utility Board	September and October 1994	The reasonableness of the projected cost and schedule estimates for the planned replacement of the steam generators at the Point Beach Nuclear Power Plant. Potential impact of the aging of structures, components, and equipment on future plant operating costs and performance.
Public Utility Commission of Texas	12700	City of El Paso, Texas	June 1994	Whether El Paso Electric Company's share of Palo Verde Unit 3 capacity was needed to ensure adequate system reliability. Whether the Company's investment in Palo Verde Unit 3 could be expected to generate cost savings for ratepayers within a reasonable number of years.
Arizona Corporation Commission	U-1551-93-272	Staff of the Arizona Corporation Commission	May and June 1994	The prudence of Southwest Gas Corporation's plastic and steel pipe repair and replacement programs.
Connecticut Department of Public Utility Control	92-04-15	Connecticut Office of Consumer Counsel	March 1994	Northeast Utilities' management of the planning for the replacement of the steam generators at Millstone Unit No. 2 and the 1992/1993 replacement outage. The causes of the steam generator degradation experienced at Millstone Unit 2 during the 1980s. The reasonableness of the Company's selection of the main contractors for the engineering and installation of the replacement steam generators. The reasonableness of a settlement between Northeast Utilities' and the main contractor for the project concerning inadequate performance by the contractor during the early months of the steam generator replacement outage.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
Connecticut Department of Public Utility Control	92-10-03	Connecticut Office of Consumer Counsel	August 1993	Whether the July - November 1991 outage of Millstone Unit 3 due to the corrosion of safety-related plant piping systems was the result of imprudent management. The information that was known by management prior to the outage concerning the potential for erosion corrosion/galvanic corrosion of the piping in the Unit's service water system.
Public Utility Commission of Texas	11735	Texas Office of Public Utility Counsel	April and July 1993	Whether any of the outages of Comanche Peak Unit 1 between August 13, 1990 and June 30, 1992 were caused or extended by imprudent management. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended plant outages could have been avoided or addressed prior to the outage. The reasonableness of Texas Utilities' maintenance practices and corrective action program at Comanche Peak. Quantification of the replacement power costs attributable to specific instances of imprudent management. The actual versus the expected net electrical output of Comanche Peak Unit 1.
Connecticut Department of Public Utility Control	91-12-07	Connecticut Office of Consumer Counsel	January 1993 August 1995	Whether the November 6, 1991 pipe rupture at Millstone Unit 2 and the related outages of the Connecticut Yankee and Millstone units were the result of imprudent management. NU's management of the pipe erosion/corrosion inspection programs at the Millstone Station. Impact of environmental requirements on plant design and operation.
Connecticut Department of Public Utility Control	92-06-05	Connecticut Office of Consumer Counsel	September 1992	The levels of off-system capacity sales that should be attributed to United Illuminating Company in rate proceeding.
Public Utilities Commission of Texas	10894	Texas Office of Public Utility Counsel	August 1992	Whether the outages of the River Bend Nuclear Station during the period October 1, 1988 through September 30, 1991 were caused or extended by imprudent management. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended plant outages could have been avoided or addressed prior to the outage. Gulf States Utilities' management of the corrective action program at River Bend. Mismanagement by outage contractors. Quantification of the replacement fuel and power costs attributable to each identified instance of imprudent management.
Connecticut Department of Public Utility Control	92-01-05	Connecticut Office of Consumer Counsel	August 1992	Whether the shutdown of Millstone Unit 3 on July 25, 1991 due to the fouling of important plant systems by blue mussels was the result of imprudent management. Design deficiencies which left 130 feet of the Millstone Unit 3 service water system unprotected against fouling by blue mussels. The reasonableness of management's response to this known design defect. The reasonableness of management's response to proposals by plant engineering and operations personnel during the years 1985 through 1988 that the plant be modified to provide protection against fouling for the entire service water system.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
California Public Utilities Commission	90-12-018	The Division of the Ratepayer Advocate of the California Public Utilities Commission Staff	November 1991 March 1992 June and July 1993	Whether any of outages of the three units at the Palo Verde Nuclear Generating Station during 1989 and 1990 were caused or extended by management imprudence. Whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended outages could have been avoided or addressed prior to the outage. Whether specific plant operating cost and capital expenditures were necessary and prudent.
Public Utilities Commission of Texas	9945	The City of El Paso, Texas	July 1991	The level of system reliability that was adequate for the interconnected El Paso Electric Company system. When the Company's share of Palo Verde Unit 3 capacity would be needed to ensure adequate system reliability. Whether the Company's investment in Palo Verde Unit 3 would produce a net economic benefit for ratepayers within a reasonable number of years. Quantification for a Commission finding that Palo Verde Unit 3 represented excess capacity. El Paso Electric Company's management of the planning and licensing of the Arizona Interconnection Project transmission line.
Arizona Corporation Commission	U-1345-90-007	Staff of the Arizona Corporation Commission	December 1990 and April 1991	The reasonableness of Arizona Public Service Company's management of the planning, construction, and operation of the Palo Verde Nuclear Generating Station. The reasonableness of management's responses to changing circumstances and to identified design and equipment issues. Quantification of identified instances of imprudent management.
New Jersey Board of Public Utilities	ER89110912J	New Jersey Rate Counsel	July and October 1990	The economic costs and benefits of the early retirement of the Oyster Creek Nuclear Plant versus continued operation through the unit's scheduled retirement in the year 2009. The potential impact of the unit's early retirement on system reliability. The cost and schedule of siting, designing and constructing a replacement natural-gas fired generating facility. Opportunities for the utility to make off-system purchases of replacement capacity if Oyster Creek were retired. The potential impact of the aging of plant structures, components, and equipment on the future operating costs and performance of the Oyster Creek unit.
Public Utilities Commission of Texas	9300	Texas Office of Public Utility Counsel	June and July 1990	Whether Texas Utilities prudently managed the design and construction of the Comanche Peak Nuclear Plant. The impact of regulatory issues on construction costs and schedule. Flaws and biases in the Company's cost and schedule variance analyses. The impact of imprudence by equipment vendors. Whether Texas Utilities was prudent in repurchasing minority owners' shares of Comanche Peak without examining the economic costs and benefits of the repurchase on its ratepayers. Whether Texas Utilities repurchase of the minority owners' shares of Comanche Peak was reasonable in light of other more economic alternatives available to the Company.
Federal Energy Regulatory Commission	EL-88-5-000	Municipal utilities in Massachusetts	November 1989	The prudence of Boston Edison's corporate management of the Pilgrim Nuclear Station.
Connecticut Department of Public Utility Control	89-08-11	Connecticut Office of Consumer Counsel	November 1989	The levels of off-system capacity sales that should be attributed to United Illuminating Company in a rate proceeding.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
Kansas State Corporation Commission	164,211-U	Staff of the Kansas Corporation Commission	April 1989	The causes of the 1987 and 1988 extended outages of the Wolf Creek generating facility. Whether any of the 127 days of outage time were the result of the mismanagement of outage activities. The impact of unscheduled outage work.
Public Utilities Commission of Texas	8425	Texas Office of Public Utility Counsel	March 1989	Whether the capacity from Houston Lighting & Power Company's new Limestone Unit 2 generating facility was required to provide adequate system reliability. Whether the Company's investment in Limestone Unit 2 would produce a net economic benefit for ratepayers. The prudence of the Company's planning for the addition of Limestone Unit 2 to its system. Whether the Company reevaluated its commitment to build Limestone Unit 2 in light of changed circumstances.
Illinois Commerce Commission	83-0537 84-0555 (On Remand)	Illinois Governor's Office of Consumer Services	January 1989	The prudence of Commonwealth Edison Company's management of quality assurance and quality control activities and the activities of project contractors during the construction of the Byron Nuclear Station. The cost and schedule consequences of specific instances of imprudent management.
New Mexico Public Service Commission	2146 Part II	Attorney General of the State of New Mexico	October 1988	The economic consequences for ratepayers of retaining the use of the Company's share of Palo Verde Units 1 and 2.
United States District Court for the Eastern District of New York	87-646-JBW	Counties of Nassau and Suffolk, New York	October 1988	Whether the Long Island Lighting Company disclosed the existence of agreements with another utility and other information in internal Company documents to the New York State Public Service Commission, the New York State Board on Electric Generating Siting and the Environment, and the U.S. Nuclear Regulatory Commission.
Public Utility Commission of Texas	6668	Texas Office of Public Utility Counsel	August 1988 June 1989	Houston Lighting & Power Company's management of the design and construction of the South Texas Nuclear Project. The reasonableness of HL&P's selection of the primary project contractors. Inconsistencies between Company positions in this proceeding and arguments HL&P had made in earlier litigation against a project contractor. The impact of safety-related and environmental statutes and regulatory requirements on plant construction costs and schedule. Quantification of the impact of identified imprudent management on construction schedule.
Federal Energy Regulatory Commission	ER88-202-000	Public Advocate of the State of Maine	June 1988	Whether the duration of the 1987 outage of the Maine Yankee Nuclear Plant was extended and/or the cost of the outage was increased by imprudent management. The causes of the turbine generator vibration problems experienced at the end of the outage. Whether work by contractors during the outage was prudently managed and performed.
Illinois Commerce Commission	87-0695	Illinois Governor's Office of Consumer Services	April 1988	The reasonableness of Illinois Power Company's planning for the Clinton Nuclear Station. The information that was available to management during 1983 and 1985 that showed that completion of the Clinton facility was not in the economic interests of the Company's ratepayers. The need for adoption of a performance standard for the Clinton plant.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
North Carolina Utilities Commission	E-2, Sub 537	Attorney General of the State of North Carolina	February 1988	Carolina Power & Light Company's management of the design and construction of the Harris Nuclear Project. Company management of quality assurance and quality control activities and the work performed by project contractors during construction. The reasonableness of the responses by Company management to changing regulatory requirements. The impact of safety-related and environmental statutes and regulatory requirements on construction costs and schedule. The cost and schedule consequences of identified instances of imprudent management.
Ohio Public Utilities Commission	87-689-EL-AIR	Cities and Consumer Organizations	October 1987	Whether any of the Company's share of capacity from the Perry Unit 2 generating facility was needed to ensure adequate system reliability. Whether the Company's investment in Perry Unit 1 would produce a net economic benefit for ratepayers.
North Carolina Utilities Commission	E-2, Sub 526	Attorney General of the State of North Carolina	June 1987	Fuel factor calculations for the Carolina Power & Light Company.
New York State Public Service Commission	29484	New York State Consumer Protection Board and the counties of Nassau and Suffolk, New York	May 1987	The planned startup/power ascension testing program and schedule for the Nine Mile Point Unit 2 generating facility.
Illinois Commerce Commission	86-0043 86-0096	City of Chicago, IL	April 1987	The reasonableness of terms in proposed Power Supply Agreement.
Illinois Commerce Commission	86-0405	Illinois Governor's Office of Consumer Services	March 1987	The appropriate in-service criteria to be used to determine when a new generating facility was capable of providing safe, adequate, reliable, and efficient service.
Indiana Public Service Commission	38045	Indiana Office of Consumer Counsel	December 1986	The prudence of Northern Indiana Public Service Company's planning for the Schaefer Unit 18 generating facility. Whether the Company reevaluated its commitment to construct Schaefer Unit 18 in light of changed circumstances. Whether the capacity from Unit 18 was required to ensure adequate system reliability. The rate consequences of excess capacity on the Company's system. Flaws and biases in the Company's economic and system reliability analyses.
Superior Court in Rockingham County, New Hampshire	86E328	Elected Officials	July 1986	The radiation effects of low power testing on structures, equipment and components in a new nuclear power plant.
New York State Public Service Commission	28124	New York State Consumer Protection Board and Suffolk County, New York	April 1986 May 1987	The reasonableness of terms and provisions in contract with equipment supplier. Prudence of utility's planning for addition of new generating facility. Reasonableness of expenditures on canceled generating facility.
Arizona Corporation Commission	U-1345-85	Consumer Organization	February 1986	Comparison of the construction schedule for the Palo Verde Unit 1 generating facility and the construction schedules for comparable nuclear power plants. Regulatory and engineering factors that would likely affect future plant operating costs.
New York State Public Service Commission	29124	New York State Consumer Protection Board	January 1986	The prudence of Niagara Mohawk Power Corporation's management of construction of the Nine Mile Point Unit No. 2 nuclear power plant.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
New York State Public Service Commission	28252	New York State Consumer Protection Board	October 1985	Performance standard for the Shoreham nuclear power plant.
New York State Public Service Commission	29069	New York State Consumer Protection Board	August 1985	Performance standard for the Nine Mile Point Unit No. 2 nuclear power plant.
Illinois Commerce Commission	83-0537 84-0555	Illinois Governor's Office of Consumer Services	July 1985	The prudence of Commonwealth Edison Company's management of quality assurance and quality control activities and the activities of project contractors during the construction of the Byron Nuclear Station. The cost and schedule consequences of specific instances of imprudent management.
Missouri Public Service Commission	ER-85-128 EO-85-185	Missouri Office of Public Counsel	July 1985	The impact of safety-related regulatory requirements on power plant operating costs and performance. The potential impact of the aging of power plant structures, components and equipment on operating costs and performance. Regulatory factors and plant-specific engineering design features that will likely affect the future operating costs and performance of the Wolf Creek Nuclear Plant.
Massachusetts Department of Public Utilities	84-152	Attorney General of the Commonwealth of Massachusetts	January 1985	The impact of safety-related and environmental statutes and regulatory requirements on power plant operating costs and performance. The potential impact of the aging of power plant structures, components and equipment on operating costs and performance. Regulatory factors and plant-specific engineering design features that will likely affect the future operating costs and performance of the Seabrook Nuclear Plant.
Maine Public Utilities Commission	84-113	Staff of the Maine Public Utilities Commission	September 1984	The impact of safety-related and environmental statutes and regulatory requirements on power plant operating costs and performance. The potential impact of the aging of power plant structures, components and equipment on operating costs and performance. Regulatory factors and plant-specific engineering design features that will likely affect the future operating costs and performance of the Seabrook Nuclear Plant.
South Carolina Public Service Commission	84-122-E	South Carolina Consumer Advocate	August 1984	The reasonableness of the repair/replacement strategy adopted by management in response to pipe cracking at the Brunswick Nuclear Station in light of what management knew or should have known about the potential for pipe cracking in safety-related systems. Quantification of replacement power costs attributable to identified instances of imprudent management.
Vermont Public Service Board	4865	Vermont Public Interest Research Group	May 1984	The reasonableness of the repair/replacement strategy adopted by management in response to pipe cracking at the Vermont Yankee Nuclear Plant. Whether that strategy was economically justified in light of what management knew or should have known about the potential for pipe cracking in safety-related systems.
New York State Public Service Commission	28347	New York State Consumer Protection Board	January 1984	The information that was available to Niagara Mohawk Power Corporation management prior to 1982 concerning the potential for cracking in safety-related piping components at the Nine Mile Point Unit No. 1 generating facility.

COURT OR COMMISSION	CASE OR DOCKET	CLIENT	DATE	ISSUE(S)
New York State Public Service Commission	28166	New York State Consumer Protection Board	February 1983 February 1984	Whether the January 25, 1982 steam generator tube rupture at the Ginna Nuclear Plant was caused by imprudent management. The information available prior to January 1982 that should have led management to conduct a visual inspection of the unit's steam generator to search for the presence of a foreign object. The plant output that was lost as a result of the January 25, 1982 tube rupture and subsequent repair outage.
U.S. Nuclear Regulatory Commission	50-247SP	Members of New York City Council	May 1983	The economic consequences of the early retirement of the Indian Point nuclear plants.

ATTACHMENT 2

OTHER SIGNIFICANT STUDIES, INVESTIGATIONS, AND LITIGATION SUPPORT WORK (Non-Confidential) 1981 - Present

DATE	CLIENT	PROJECT
1997	Connecticut Office of Consumer Counsel	Investigated whether the current outages of the three Millstone Nuclear Units were caused or extended by imprudent management. Examined whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended these outages could have been avoided or addressed prior to the outage.
1997	Attorney General of the Commonwealth of Massachusetts	Investigated whether the current outages of the three Millstone Nuclear Units were caused or extended by imprudent management. Examined whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended these outages could have been avoided or addressed prior to the outage.
1997	New Jersey Division of Ratepayer Advocate	Reviewed the U.S. Nuclear Regulatory Commission's Draft Policy Statement on Electric Industry Economic Deregulation.
1996	New Jersey Division of Ratepayer Advocate	Investigated whether the current outages of the two units at the Salem Nuclear Station were caused or extended by imprudent management. Examined whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended these outages could have been avoided or addressed prior to the outage.
1996	Municipal Electric Utility Association of New York State	Evaluated a recent utility estimate of the expected cost of decommissioning the Fitzpatrick nuclear plant.
1996	Attorney General of the Commonwealth of Massachusetts	Investigated whether the outages of the Pilgrim, Millstone, Connecticut Yankee, Vermont Yankee, and Maine Yankee nuclear plants during the years 1995 and 1996 were caused or extended by imprudent management.
1996	Associated Industries of Massachusetts	Assisted client in quantifying the stranded costs associated with utility generating facilities in the New England states.
1996	Staff of the Arizona Corporation Commission	Assessed whether U.S. West Corporation's repair and replacement programs for telephone cable in Arizona were reasonable. Explored the impact of performance-based regulation on these utility programs.
1995-1996	City Public Service Board of San Antonio, Texas	Confidential
1995	Attorney General of the State of Michigan	Investigated whether the December 25, 1993 turbine generator failure and fire at the Fermi 2 generating plant was caused by Detroit's imprudent management of fabrication, operation or maintenance.
1995	Environmental Law and Policy Center of the Midwest	Investigated the potential safety consequences of steam generator tube cracking at the Byron and Braidwood nuclear stations.
1995	None	Analyzed the potential impact on nuclear power plant safety of increased competition in the electric industry.

DATE	CLIENT	PROJECT
1995	Attorney General of the Commonwealth of Massachusetts	Investigated whether the outages of the Millstone nuclear units during the years 1993 and 1994 were caused or extended by imprudent management.
1994-1995	Texas Office of Public Utility Counsel	Investigated whether the outages of the two units at the South Texas Nuclear Generating Station during the years 1990 through 1994 were caused or extended by imprudent management. Examined whether the equipment problems, personnel performance weaknesses, and program deficiencies which led to or extended these outages could have been avoided or addressed prior to the outage.
1994	Investment Firms	Examined the technical risks associated with investment in the Great Bay Power Company.
1994	Attorney General of the Commonwealth of Massachusetts	Investigated whether the outages of the Millstone and Maine Yankee nuclear plants during 1992 were caused or extended by imprudent management.
1993-1994	Public Advocate of the State of Maine	Evaluated the 1994 Decommissioning Cost Estimate for the Maine Yankee Nuclear Plant.
1993	Attorney General of the Commonwealth of Massachusetts	Investigated whether the outages of the Millstone nuclear units during 1991 were caused or extended by imprudent management.
1992-1993	Consumer Advocate Division of the West Virginia Public Service Commission	Analyzed whether proposed transmission line was needed to ensure adequate system reliability.
1992	Oregon Public Policy Coalition	Examined the potential impacts of the aging of power plant structures, components and equipment on the likely future operating costs and performance of the Trojan Nuclear Plant. Evaluated the reasonableness of the assumptions used in the utility's analysis of the economics of continued operation of the Trojan unit versus early retirement.
1992	New Jersey Rate Counsel	Examined whether a proposed natural-gas fired generating facility was needed to ensure adequate system reliability. Reviewed the planned licensing and construction schedules for the unit. Examined the potential impact of environmental requirements on the unit's expected construction cost and schedule.
1992	New York State Consumer Protection Board	Evaluated whether the utility's strategy for the repair and replacement of the steam generators at the Indian Point 2 nuclear plant was reasonable.
1990-1991	Shareholders of Public Service Company of New Mexico	Examined if Company management had known or should have known that the New Mexico Public Service Commission was considering whether to exclude the Company's investment in Palo Verde Units 2 and 3 from rate base. Examined whether management had adequately disclosed to potential investors its inability to market the resulting excess capacity.
1989	Connecticut Office of Consumer Counsel and the Attorney General of the State of Connecticut	Investigated whether the Seabrook Nuclear Plant was prudently engineered and constructed.
1988-1989	North Carolina Electric Municipal Power Agency	Investigated whether Carolina Power & Light Company had prudently managed the design and construction of the Harris nuclear plant. Examined the impact of safety-related and environmental statutes and regulatory requirements on power plant construction costs.
1988	Arkansas Public Service Commission	Investigated whether the Grand Gulf nuclear plant had been prudently designed and constructed.

DATE	CLIENT	PROJECT
1988	City of Fayetteville, North Carolina	Investigated whether Carolina Power & Light Company had prudently managed the design and construction of the Harris nuclear plant. Examined the impact of safety-related and environmental statutes and regulatory requirements on power plant construction costs.
1987	New York State Consumer Protection Board	Reviewed financial incentives proposed by Public Service Commission to improve nuclear power plant safety.
1986-1987	New Jersey Rate Counsel	Assisted client in a prudence review of the construction cost and schedule of the Hope Creek Nuclear Generating Station.
1985	Colorado Office of Consumer Counsel	Prepared an engineering review of the performance of the Fort St. Vrain Nuclear Plant.
1982-1983	New York State Consumer Protection Board	Represented the Consumer Protection Board in a Public Service Commission proceeding investigating whether the Nine Mile Point Unit No. 2 nuclear plant should be completed and in court appeals arising from that proceeding.
1981-1982	New York State Consumer Protection Board	Prepared an economic and engineering critique of the National Reliability Study published by the U.S. Department of Energy in 1981.

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Expertise

Geotechnical Engineering
Earthquake Engineering
Transportation Engineering
Hazardous Waste Management
Applied Statistics
Project Management

Education

Ph.D., Civil Engineering (geotechnical), Brigham Young University, 1992.

B.S., Geology, Brigham Young University, 1983.

Professional History

Utah Dept. of Transportation, Research Project Manager, Research Division, 1998 - present.

Woodward-Clyde Consultants, Project Engineer, 1996-1998.

Westinghouse Savannah River Company, Senior Engineer, 1991-1995.

Brigham Young University, Research Assistant, 1988-1991.

Utah Department of Transportation, Preconstruction Materials Engineer, 1987-1988.

Utah Department of Transportation, Construction Technician, 1984-1987.

Geokinetics In-Situ Oil Shale Development, Retort Engineer, 1984.

Registrations

Professional Engineer: Utah

Affiliations

American Society of Civil Engineers

Experience

Past projects and research include: geotechnical and geological investigations, foundation, embankment, and pavement design, seismic hazard assessments, earthquake engineering, RCRA and CERCLA hazardous waste investigations, construction material specification, contract administration, proposal preparation, and report writing. A summary of pertinent experience follows:

- **UDOT Research on the I-15 Corridor** - Principal investigator of long-term monitoring studies to determine the field performance of innovative foundation treatments on the I-15 alignment which include: PV drains, geofoam embankments, light-weight aggregate, lime cement columns, and high-strength geotextile. Also co-principal investigator with Utah State University to determine the construction and post-construction behavior of mechanically stabilized earth (MSE) walls. Project manager for research involving carbon fiber application for seismic bridge retrofitting, non-destructive testing for bridge damage assessment, and response of pile and geopier foundation systems to lateral and uplift loads.
- **I-15 Design-Build Team** - Lead design engineer for Woodward-Clyde Consultants responsible for geotechnical design from 800 South to 2100 South on I-15 in Salt Lake City, Utah. Project included settlement calculations, staged embankment construction, liquefaction and earthquake deformation analyses, MSE wall construction and ground modification and treatment.
- **Kennecott Utah Copper Tailing Impoundment Modernization Project** - Performed steady state and transient seepage analyses for design of a tailings dewatering system for the seismic upgrade of the tailings impoundment, Magna, Utah.
- **Wasatch County Water Efficient Project** - Performed geological and geotechnical assessments of canal stability and pump station locations, Heber Valley, Utah.

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Affiliations (cont.)

Utah Seismic Safety Commission Lifelines Subcommittee

Awards and Recognitions

BYU Presidential Scholar

Alvin Barrett Scholar (Geology Department)

BYU Sigma-Chi Recipient, Outstanding Ph.D. Dissertation, 1992.

Finalist for outstanding paper, ASCE Journal Geotechnical Engineering, 1995.

Publications/Reports

Bartlett, S. F., 1999, "Seismic Risk Assessment for the I-80 Corridor," Utah Department of Transportation, Research Division, in press.

Simon, D.B., Shlemon, R.J., and Bartlett, S.F., "Holocene Ground Failure in Downtown Salt Lake City, Utah," Geological Society of America, in press.

WSRC, 1995, "In-Tank Precipitation Facility (ITP) and H-Tank Farm (HTF) Geotechnical Report," Report No. WSRC-TR-95-0057, Rev. 0, Westinghouse Savannah River Company, Aiken, S.C.

Bartlett, S.F., 1995, "Probabilistic Liquefaction Settlement Evaluation for the In-Tank Precipitation Facility (ITP)," Report No. C-CLC-H-00815, Westinghouse Savannah River Company, Aiken, S.C.

Bartlett, S. F., 1995, "Geotechnical Seismic Assessment Report for the Defense Waste Processing Facility (DWPF)," Report No. SRC-TR-95-0072, Westinghouse Savannah River Company, Aiken, S.C.

Bartlett, S. F. and Youd, T. L., April 1995, "Empirical Prediction of Liquefaction-Induced Lateral Spread," Journal of Geotechnical Engineering, ASCE.

Rouhani, S., Lin, Y.P., and Bartlett, S.F., 1995, "H-Area/ITP Geostatistical Assessment of In-Situ and Engineering Properties," Final Technical Report, ERDA Project No. 93044, Site Geotechnical Services, Westinghouse Savannah River Company, Aiken, S.C.

Experience (cont.)

- **Cainville Dam Investigation** - Project Engineer responsible for preliminary geological and geotechnical assessments of foundation conditions at the proposed dam site. Performed coring of abutment areas, pump testing, and seepage assessments, Wayne County, Utah.
- **DMAD and Gunnison Bend Dam Investigations** - Performed geotechnical investigations and assessments to determine piping potential and seismic stability these embankment dams for Utah's Dam Safety Program, Millard County, Utah
- **Seismic Retrofit of Salt Lake City Waste Water Treatment Plant** - Design and field oversight engineer responsible for jet grouting operations to stabilize potentially liquefiable soils under a pump station, North Salt Lake City, Utah.
- **Hurricane Bridge Foundation Investigation** - Performed geological and bridge foundation investigations and analyses for UDOT at the Hurricane Bridge Crossing, Hurricane, Utah.
- **ITP/H-Area Tank Farm Geotechnical Investigation and Seismic Qualification** -Principal geotechnical investigator on a multi- disciplinary team overseeing the seismic qualification of the H-Area high-level radioactive waste storage tank farm. This project included extensive subsurface investigations, strong ground motion response modeling, liquefaction hazard evaluations, dynamic settlement calculations, dynamic slope stability analyses and a probabilistic liquefaction hazard assessment for the Department of Energy at the Savannah River Site, Aiken, South Carolina.
- **Review of Foundation Investigations and Geotechnical Seismic Design of the Defense Waste Processing Facility** - Principal geotechnical investigator reviewing the Safety Analysis Report (SAR) documentation for the seismic qualification and start-up of the high-level radioactive waste vitrification and storage facilities at the Savannah River Site, Aiken, South Carolina.

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Publication/Reports (cont.)

Bartlett, S. F., 1994, "Determination of Soft Zones and Consolidation Properties for the Santee Formation," Report No. K-CLC-H-00058, Westinghouse Savannah River Company, Aiken, S.C.

Bartlett, S. F. and Youd, T. L., 1993, "Prediction of Liquefaction-Induced Ground Displacement Near Bridges," Proceedings from the U.S. National Earthquake Conference, Memphis, Tenn., May, 1993.

Bartlett, S. F., 1993, "RCRA Facility Investigation / CERCLA Remedial Investigation for the Burma Road Rubble Pit," Environmental Restoration Department, Westinghouse Savannah River Company, Aiken, S.C.

Bartlett, S. F., McMullin, S. R., and Serrato, M., 1993, "State of the Art Design: A Closure System for the Largest Hazardous Waste Landfill at the Savannah River Site," Proceedings of Waste Management '93 Symposium.

Bartlett, S. F. and Youd, T. L., 1992, "Empirical Prediction of Lateral Spread Displacement," Proceedings of 4th Japan-U.S. Workshop on Earthquake Resistant Design of Lifeline Facilities and Countermeasures Against Soil Liquefaction, May, 1992.

Bartlett, S. F., 1992, "Empirical Analysis of Horizontal Ground Displacement Generated by Liquefaction-Induced Lateral Spreads," Ph.D. dissertation and report published by National Earthquake Engineering Research Center, NCEER Report #92-0021.

Bartlett, S. F. and Youd, T. L., 1992, "Case Histories of Lateral Spreads from the 1964 Alaska Earthquake," NCEER Report #92-0002.

Bartlett, S. F. and Youd, T. L., 1990, "Evaluation of Ground Failure Displacement Associated with Soil Liquefaction: Compilation of Case Histories," Miscellaneous Paper S-73-1, U.S. Army Corps of Engineers.

Experience (cont.)

- **SRS Hazardous Waste Landfill Closure** -Project manager for RCRA Facility Investigation and closure of a 51-acre hazardous waste landfill at the Savannah River Site. Also, oversaw the preparation of CERCLA feasibility study for the same closure.
- **UDOT Preconstruction Materials Engineer** - Performed material testing and pavement design for highway alignment changes and urban interchanges in West Valley City and for the I-215 interchange at California Avenue. Evaluated compaction and quality of subgrade for east-side belt route (I-215) between 2700 South and 4500 South. Conducted geological investigations on new and existing highway alignments in Salt Lake and Heber Counties, located fill and roadbase gravel sources for construction. Tested, instrumented and monitored I-215 fill slopes for settlement and slope stability.
- **Construction Technician** - Programmed and implemented a state-wide project accounting program for the Utah Dept. of Transportation to track monthly contractual payments and construction progress. Performed field assessments of slope stability and landsliding in Provo and Spanish Fork Canyon. Also performed construction inspection and surveying for highway widening projects in Orem, Utah and Provo Canyon.