21378

RELATED CORRESPONDENCE



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 |
| | ) | March 7, 2000 |

**STATE OF UTAH'S SUPPLEMENTAL RESPONSES TO APPLICANT'S SECOND AND FOURTH SET OF DISCOVERY REQUESTS TO INTERVENORS STATE OF UTAH AND CONFEDERATED TRIBES**

The State hereby files this response supplementing State of Utah's Objections and Responses to Applicant's Second Set of Discovery Request (June 28, 1999), and State of Utah's Objections and Responses to Applicant's Fourth Set of Discovery Requests (January 31, 2000) ("State's Responses Fourth Set"), which relate to Utah Contention H (Inadequate Thermal Design).

**GENERAL OBJECTIONS**

The general objections stated in State's Responses Fourth Set are hereby incorporated by reference.

**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 preparing this supplemental discovery response. Their Declarations are attached hereto as Exhibit 1.

Marvin Resnikoff, Ph.D.
Senior Associate
Radioactive Waste Management Associates
526 West 26th Street, Room 517
New York, NY 10001

Matthew R. Lamb
Associate
Radioactive Waste Management Associates
526 West 26th Street, Room 517
New York, NY 10001

In response to whether the information or opinion 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.

**Supplement to Response to General Interrogatory No. 3.**

In response to General Interrogatory No. 3, Applicant's First Set of Formal Discovery Requests to the State dated April 2, 1999, the State identifies Matthew R. Lamb, whom it expects to call as a witness at the hearing for Utah Contention H. He has reviewed the Applicant's license application to the NRC and amendments thereto; reports and correspondence relating to the thermal design of the PFS facility; and reports and

correspondence relating to the thermal design of the HI-STORM 100 storage cask system and the HI-STAR 100 storage cask system. Included herein as Exhibit 2 is Mr. Lamb's resume which provides answers to the questions of profession, employer, area of professional expertise, and educational and scientific experience.

## II. SECOND SET OF DISCOVERY REQUESTS

Interrogatory No. 4: 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.

The State's response is to utilize the "100°F ambient off-normal" and "125°F extreme hot ambient conditions" selected by Holtec in its *Hi-Storm Thermal Analysis for PFS RAI* (Holtec Report No: HI-992134) as the temperature far away from the surface of the proposed PFS site, and calculate the "local ambient" temperature near the surface of the ISFSI pad. To do this, we utilize the following equation:

$$(1-a)I = \varepsilon\sigma(T_s^{\,4} - T_{sky}^{\,4}) + h_c(T_s - T_a)$$

I = solar flux ($W/m^2$)
a = solar reflectance
$\varepsilon$ = emittance
$T_s$ = steady-state surface temperature (K)
$T_a$ = air temperature directly above surface (K)
$T_{air}$ = "ambient" air temperature as used in Holtec/PFS calculations. The temperature high above the ground, away from influence by casks/ISFSI pad.
$T_{sky}$ = "sky temperature"

= the temperature of a black body that would radiate the same power in the thermal infrared spectrum (5-40 nm) toward the earth as does the sky

$= \varepsilon_{sky}^{\,0.25} \times T_a$
$h_c$ = convective coefficient ($W/m^2K$)

We begin our analysis using the ISFSI pad surface temperature results obtained from the FLUENT EHT computer model for "100°F ambient conditions" performed by Holtec. Holtec performed two separate "off normal ambient" computer runs, one with twice the

mesh resolution as the other. The ISFSI pad temperature results as documented on pg. 8 of HI-992134 are 372.6 K and 363.6 K. We average these two results to obtain a surface temperature of 368.1 K.

We also used a solar reflectance of 0.4, an emittance of 0.6, a convective coefficient of 6.55 $W/m^2K$, and a solar flux of 387 $W/m^2$ (averaged 12-hour design basis insolation over 24 hours).

We used the equation given above to determine what the air temperature above the heated surface would be given a surface temperature equal to 368.1 K. We assume the sky temperature to be approximately 10 K lower than the air temperature (Akbari, 1996).

Using these inputs, the temperature directly above the ISFSI pad is calculated to be approximately 180°F.

To check this calculation, and to obtain a temperature gradient away from the ISFSI pad at distances up to the top of the air inlet duct (.254 meters), we used the "One-Seventh Power Law Approximation" (Levinson, 1997). This equation is reproduced below.

$$T_a = T_\infty + [T_o - T_\infty][1 - \theta(\bar{h})]$$

$$\bar{h} = \bar{H}_o / \Delta$$

$$\theta(\bar{h}) = \bar{h}^{1/7} \quad ; \bar{h} < 1$$

$T_o$ ground surface temperature (K)
$T_{inf}$ free air temperature
$T_a$ air temp at height h
$\Delta$ boundary layer thickness, m
We will use a boundary layer of 2 m.

Since we are using a boundary layer of 2m, we take $T_{inf}$ to be the air temperature given in the FLUENT output for the 100°F ambient conditions case. This is approximately 314.5K. Also, we take the surface temperature equal to 368.1K, and we obtain an air temperature very near the ground to be approximately 350K, or 168°F. The difference between calculated results is approximately 2% (356 K vs 350 K).

However, the air will be flowing into the air inlet duct at distances up to about 10 inches

above the ISFSI pad. Therefore, an average temperature value is needed over this range of values. For the 100°F "ambient case," this is provided below along with a comparison of the average temperature results for the two FLUENT models run by Holtec for 100°F ambient conditions. The "Average" temperature is calculated only using temperatures at distances calculated by Holtec.

| M68PFS (Original Mesh Case) | | |
|---|---|---|
| Distance from ISFSI pad meters | Temperature, Power Law Results Kelvin | Temperature, FLUENT Kelvin |
| 0.00E+00 | 372.60 | 363.60 |
| 1.00E-03 | 352.98 | -- |
| 0.0254 | 341.46 | 317.76 |
| 0.0762 | 336.17 | 315.41 |
| 0.127 | 333.41 | 314.74 |
| 0.1778 | 331.48 | 314.46 |
| 0.2286 | 329.98 | 314.30 |
| **Average Temperature, K** | 334.50 | 315.33 |
| **Average Temperature, F** | 142.43 | 107.93 |

| M68PFS2 (Refined Mesh Case) | | |
|---|---|---|
| Distance from ISFSI pad meters | Temperature, Power Law Results Kelvin | Temperature, FLUENT Kelvin |
| 0.00E+00 | 363.60 | 363.60 |
| 0.001 | 347.02 | -- |
| 0.0127 | 339.77 | 320.70 |
| 0.0381 | 335.72 | 317.01 |
| 0.0635 | 333.61 | 316.95 |
| 0.0889 | 332.13 | 316.76 |
| 0.1143 | 330.98 | 316.67 |
| 0.1397 | 330.03 | 316.59 |
| 0.1651 | 329.22 | 316.53 |
| 0.1905 | 328.51 | 316.47 |
| 0.2159 | 327.88 | 316.43 |
| 0.2413 | 327.30 | 316.38 |
| **Average Temperature, K** | 331.51 | 317.05 |
| **Average Temperature, F** | 137.05 | 111.02 |

From this, we recommend that PFS/Holtec use a value of approximately 140°F in place of the 100°F "off-normal ambient" calculation presented in HI-992134.

The FLUENT case files provided to the State do not have temperature results for the 125°F "extreme hot" conditions. Therefore, we will scale up our numbers based on ratios between the values used by FLUENT and our values obtained using the 1/7 Power Law. This results in our recommendation that PFS/Holtec use a value of approximately 167°F in place of the 125°F "extreme hot ambient" calculation presented in HI-992134.

**References**

Akbari, H., R. Levinson, And P. Berdahl, 1996. "ASTM Standards for Measuring Solar Reflectance and Infrared Emittance of Construction Materials and Comparing their Steady-State Surface Temperature."

Pacific Grove, CA. *Proceedings of the 1996 ACEEE Summer Study on Energy Efficiency in Buildings,* 1, pg 1. Also, report No. LBL-38676.
Levinson, R., 1997. "Near-ground cooling efficacies of trees and high-albedo surfaces," Lawrence Berkeley National Laboratory Report LBL-38678.
*Hi-Storm Thermal Analysis for PFS RAI* (Holtec Report No: HI-992134)

Interrogatory No. 5. 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: To the extent that PFS adheres to ACI-349, Appendix A, then the specified temperature limits are correct.

Requests for Admission Nos. 4-7:

4. Do you admit that an annual average ambient temperature of 75 °F. or more has never been recorded for any location in Skull Valley?

5. 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?

6. Do you admit that an annual average ambient temperature of 75 °F. or more has never been recorded for any location in Utah?

7. 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 REQUESTS FOR ADMISSION NOS. 4-7: The State does not have any additional information to add to its previous responses.

Interrogatories Nos. 1-3:

1. 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.

2. 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.

3. 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.

Document Production Requests Nos. 3-5:

3. 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.

4. 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.

5. All documents containing temperature data and other data that support the State's contentions in Interrogatory Nos. 1-5.

RESPONSE TO INTERROGATORIES NOS. 1-3 AND DOCUMENT PRODUCTION REQUESTS NOS. 3-5:

The State does not have any information to add to its previous responses.

## III. FOURTH SET OF DISCOVERY REQUESTS

### 1. Requests for Admission – Utah H

Request for Admission No. 16. Do you admit that the temperature limit of 775°F for "canister shell temperature," as stated in Table 1 of Attachment 1 to Holtec International's December 13, 1999 submittal to the NRC Staff entitled "PFS EHT Thermal Modeling Features Sensitivity Study," is a valid and correct temperature limit for the HI-STORM cask?

RESPONSE TO ADMISSION REQUEST NO. 16 - UTAH H. Admitted that these are the temperature limits for accident conditions.

Request for Admission No. 17. Do you admit that the temperature limit of 1058°F for "peak cladding temperature," as stated in Table 1 of Attachment 1 to Holtec International's December 13, 1999 submittal to the NRC Staff entitled "PFS EHT Thermal Modeling Features Sensitivity Study," is a valid and correct temperature limit for the HI-STORM cask?

RESPONSE TO ADMISSION REQUEST NO. 17 - UTAH H. Admitted that these are the temperature limits for accident conditions.

**2. Interrogatories – Utah H**

Interrogatory No.1. Identify and explain in detail any and all errors, and the bases therefor, that the State alleges to be in the EHT model thermal analysis of the HI-STORM storage cask at the PFSF site performed by Holtec International for PFS, including the December 13, 1999 sensitivity studies.

RESPONSE TO INTERROGATORY NO. 1 - UTAH H. After reviewing the December 13, 1999, submittal to the NRC entitled "PFS EHT Thermal Modeling Features Sensitivity Study," the State does not have any changes to our January 31, 2000, response to this interrogatory.

Interrogatory No.2. Identify in detail any and all temperature limits that the State alleges that would be violated, and the bases therefor, by storing PFSF design basis fuel in the HI-STORM storage cask at the PFSF site.

RESPONSE TO INTERROGATORY NO. 2 - UTAH H. The State has done preliminary calculations regarding temperature limits, but has not yet had an opportunity to compare them with design basis temperature limits. The State anticipates that it will

perform additional calculations. The calculations that the State has performed will be produced and are available for inspection and copying.[1]

Interrogatory No.4. Explain, including providing all bases, the State's assertion that the hypothetical reflecting boundary used in the EHT model thermal analysis performed by Holtec for PFS does not envelope the radiation heat transfer from adjacent casks in the PFSF storage cask array.

RESPONSE TO INTERROGATORY NO. 4 - UTAH H. *See* response to Interrogatory No. 1 above.

DATED this 7th day of March, 2000.

Respectfully submitted,

Denise Chancellor, Assistant Attorney General
Fred G Nelson, Assistant Attorney General
Connie Nakahara, Special Assistant Attorney General
Diane Curran, Special Assistant Attorney General
Laura Lockhart, Assistant Attorney General
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[1] These documents will be available at the depositions being conducted on March 8 and 9, 2000.

CERTIFICATE OF SERVICE

I hereby certify that a copy of STATE OF UTAH'S SUPPLEMENTAL RESPONSES TO APPLICANT'S SECOND AND FOURTH SET OF DISCOVERY REQUESTS TO INTERVENORS STATE OF UTAH AND CONFEDERATED TRIBES was served on the persons listed below by electronic mail (unless otherwise noted) with conforming copies by United States mail first class, this 7th day of March, 2000:

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U. S. Nuclear Regulatory Commission
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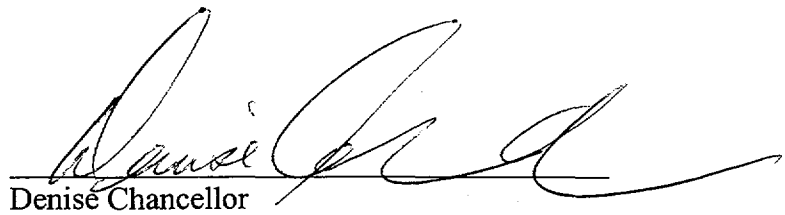


Denise Chancellor
Assistant Attorney General
State of Utah

# EXHIBIT 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | |
|---|---|
| In the Matter of: | Docket No. 72-22 |
| Private Fuel Storage, LLC (Independent Spent Fuel Storage Installation) | ASLBP No. 97-732-02-ISFSI |
| | March 7, 2000 |

## DECLARATION OF DR. MARVIN RESNIKOFF

Under penalty of perjury, I, Dr. Marvin Resnikoff, declare that the statements contained in State of Utah's Supplemental Responses to Applicant's Second and Fourth Sets of Discovery Requests, dated March 7, 2000, are true and correct to the best of my knowledge, information, and belief.

Dated this 7th day of March, 2000

Marvin Resnikoff, Ph.D.
Senior Associate
Radioactive Waste Management Associates

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

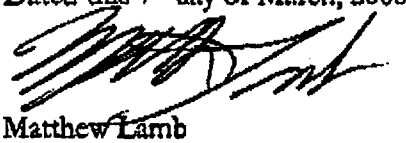
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | |
|---|---|
| In the Matter of: | Docket No. 72-22 |
| Private Fuel Storage, LLC (Independent Spent Fuel Storage Installation) | ASLBP No. 97-732-02-ISFSI |
| | March 7, 2000 |

**DECLARATION OF MATTHEW R. LAMB**

Under penalty of perjury, I, Matthew R. Lamb, declare that the statements contained in State of Utah's Supplemental Responses to Applicant's Second and Fourth Sets of Discovery Requests, dated March 7, 2000, are true and correct to the best of my knowledge, information, and belief.

Dated this 7th day of March, 2000



Matthew Lamb
Associate
Radioactive Waste Management Associates

# EXHIBIT 2

**Matthew Raymond Lamb**
307 E. 37th Street #5
New York, NY 10016
212.922.9304
mrlamb@rwma.com

**EDUCATION:**

**Stanford University** *June 1999*
Stanford, CA
*Master of Science in Environmental Engineering & Science*

**Northwestern University** *June 1998*
Evanston, IL
*Bachelor of Science in Environmental Engineering, cum laude and departmental honors*

**WORK EXPERIENCE:**

*Research Associate,* **Radioactive Waste Management Associates, New York, NY.** Focus on containment of radioactive waste and the consequences of releases of radioactive material. Employs extensive computer modeling for estimating health and economic consequences of radioactive materials transportation, spent nuclear fuel transportation and storage, and fate and transport of contaminants in the environment. *August 1999-present.*

*Web Page Designer,* **Argonne National Laboratory, Argonne, IL.** Designed and created a waste minimization and pollution prevention web site using HTML and Microsoft FrontPage '98. *October 1998-October 1999.*

*Illinois EPA Graduate Intern in Pollution Prevention,* **Argonne National Laboratory, Argonne, IL.** Created a laboratory chemical exchange system; performed cost-benefit analysis of potential savings due to waste minimization; developed the Argonne Chemical Exchange System web site. *June 1998-September 1998.*

*Intern, Environment, Safety & Health Department,* **Fermi National Accelerator Laboratory, Batavia, IL.** Designed and constructed radiation shielding apparatuses; tested and evaluated of radiation cooling exhaust systems; developed a hazardous material recycling center; performed routine occupational exposure analyses; completed feasibility studies for waste minimization projects. *June 1996 –September 1996; March 1997 – September 1997.*

**RESEARCH EXPERIENCE:**

**Stanford University**: Master's research work on enzymatic degradation of vinyl chloride and atrazine through DNA shuffling.

**Northwestern University**: Performed an in-depth site characterization and risk assessment (Tier I and Tier II) of an abandoned industrial site in Chicago, IL for undergraduate thesis project.

**SPECIAL SKILLS:**

**Computers**: Proficient in all Microsoft Office Programs, Microsoft FrontPage '98 desktop publishing system, Windows, Macintosh, or Unix operating systems. Knowledge of FORTRAN and MATLAB programming languages, especially in their use to model complex physical phenomena. Proficient in the use of radiation transportation consequence assessment computer models (RADTRAN and RISKIND), air pollution models (ISCST, CALINE), and knowledgeable in the theoretical bases of computational fluid dynamics computer programs, including FLUENT.

## Matthew Lamb

Matthew Lamb has a sound background in radiation physics, fluid mechanics, and fate and transport of environmental contaminants. As a student, both at Northwestern and Stanford, he has taken courses in fluid mechanics and heat transfer, physics, thermodynamics, numerical modeling and simulation, radiation health engineering, hazardous waste management, and FORTRAN programming. His coursework has also included atmospheric chemistry and physics, including study on near-ground surface effects on temperature.

While employed at the Fermi National Accelerator Laboratory, Mr. Lamb's work included testing the shielding and ventilation of enclosures housing radiation-heated experimental apparatuses, obtaining certification as a Department of Energy Radiological Control Technician. During his undergraduate studies at Northwestern, he performed an in-depth site characterization and risk assessment of a "brownfield" site, acting as a consultant for a legal clinic representing community groups in the area. This work included modeling the transport of heavy metals in the surface water and groundwater.

Mr. Lamb received his M.S. in Environmental Engineering and Science from Stanford, where he conducted research in microbiology as part of his Master's thesis. At RWMA, Mr. Lamb has focused on the storage and transportation of radioactive waste and spent nuclear fuel. He is responsible for developing, analyzing, and running computer models for consequence assessments of radioactive releases, along with estimating container responses to environmental stresses.