UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

DECLARATION OF INDRESH RAMPALL

Indresh Rampall states as follows under penalties of perjury:

1. I am a principal engineer at Holtec International. In that position I am responsible for performing engineering and thermal analysis of spent fuel storage systems. I am providing this declaration, in support of a motion for a protective order submitted by Private Fuel Storage, L.L.C. ("PFS") in the above captioned proceeding, to demonstrate the unreasonableness of the cost and burden the State of Utah ("State") asks PFS to bear in responding to the State's discovery request.

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 1 to this declaration. Since my employment at Holtec International, a substantial portion of my work has been directed towards thermal qualification of spent fuel storage systems in wet and dry conditions. I have performed the expanded HI-STORM thermal (EHT) model incorporating second order thermal effects for the HI-STORM 100 spent fuel storage cask to be used at the Private Fuel Storage Facility (PFSF) for the storage of spent nuclear fuel.

3. In performing the EHT analysis for the HI-STORM 100, I used the "FLUENT" thermal-hydraulic computer code. I use the FLUENT code in performing thermal-hydraulic analyses as part of my responsibilities at Holtec. I

am also responsible for the FLUENT code installation at Holtec and for maintaining Holtec's license with Fluent, Inc. to run the FLUENT code at Holtec.

4. It is not possible for PFS or Holtec to copy the FLUENT code and provide it to the State. The FLUENT code is commercially available from Fluent, Inc. It was developed by and is the intellectual property of Fluent, Inc. As such, Holtec acquired the FLUENT code by purchasing it from Fluent, Inc. along with a license to use the code on a single, identified computer at Holtec. Fluent, Inc. supplies a software license key (which is renewable annually) that enables the FLUENT code to be run only on one computer at Holtec. It is not possible to run the FLUENT code without the software license key. Holtec provided to Fluent, Inc. the hard drive disk serial number for the computer on which Holtec would run the FLUENT code. Fluent, Inc. then wrote the software license key specifically to allow the copy of the FLUENT code it was providing Holtec to run only on the computer for which Holtec had provided the hard drive disk serial number. The code will not run on any computer with a different hard drive disk serial number. Thus, it is not possible for Holtec to copy the FLUENT code and run it on another computer at Holtec. It is also not possible for Holtec to copy the code and give it to another individual to run on some computer outside of Holtec.

5. The software license key is disabled after a date specified by Fluent, Inc. (e.g., the current Holtec license expires on January 2, 2000). If a buyer wishes to use the code after that date, it must purchase an extension of its license from Fluent, Inc. In which case, Fluent, Inc. sends the buyer a new software license key that allows the code to be run until the date specified under the extension of the buyer's license.

6. The thermal analysis of the HI-STORM 100 at the PFSF site, as performed by Holtec using the EHT model and the FLUENT code, is the subject of Contention Utah H in the above captioned proceeding. (The EHT model was used by Holtec to characterize the temperature field in a cask array at the PFSF incorporating the

heat transfer effects that the State had claimed were not present in the original thermal analysis for the HI-STORM 100.) The State of Utah requested the FLUENT code from PFS in discovery in that proceeding. After PFS informed the State that it was not possible for PFS or Holtec to copy the code and provide it to the State and that the price of the code was approximately $30,000, PFS and the State entered into discussions as to whether PFS could provide documents describing the FLUENT code in lieu of the code itself that would satisfy the State's needs.

7. Over the course of the discussions between PFS and the State, Holtec provided to the State (through PFS) a copy of the relevant sections of the User's Manual for the FLUENT code, which explains the data, equations and relationships the FLUENT code uses to calculate the temperatures of the various components of the HI-STORM 100 It also produced (1) all the "case file" input files (in text form) for the FLUENT code runs that were performed using the EHT model for Holtec Report No. HI-992134, "Hi-Storm Thermal Analysis for PFS RAI," analyzing the HI-STORM 100 spent fuel storage cask at the PFSF site (which contain all the input data for FLUENT for the EHT model runs performed for Report No. HI-992134), (2) provided the State all the output files (in text form) from the FLUENT code runs that were performed for Report No. HI-992134 (using the EHT model) in the thermal analysis of the HI-STORM 100 spent fuel storage cask at the PFSF site, (which contain all the output data from FLUENT for the EHT model runs performed for Report No. HI-992134), and (3) provided the State with electronic ZIP copies of the input and output files for Report No. HI-992134 which it could use to rerun and duplicate the results of the EHT model should it choose to purchase the FLUENT code. Thus, Holtec provided to the State (through PFS) all the input data that was used to perform the FLUENT code runs that were performed for Report No. HI-992134 (using the EHT model) in the thermal analysis of the HI-STORM 100 at the PFSF site and all the output data from those runs as that data is maintained in Holtec's usual

course of business. No other input was required or used by Holtec to perform this thermal analysis of the HI-STORM 100 at the PFSF site using the EHT model and no other output was produced by the FLUENT code for this analysis.

8. After receiving the material provided by Holtec, and after further discussions with PFS, the State dropped its request for the FLUENT code. Letter from Diane Curran, counsel for State of Utah, to William Hollaway, counsel for PFS (Dec. 16, 1999). The State now requests instead that PFS obtain for it, from Holtec, paper printouts of the computer screen images that contain the series of "yes-no" and numerical choices made in so-called "decision boxes" that appear in the FLUENT code User's Manual tutorial pages. Id.; Letter from Diane Curran, counsel for State of Utah, to William Hollaway, counsel for PFS (Dec. 14, 1999). The so-called "decision boxes" for which the State requests the computer screen images are merely alternative, redundant devices a user can employ to create the case file (i.e., input file) for FLUENT. There are other such devices in FLUENT as well and a user may display and use any of the input devices on the computer screen for inputting data. (In fact, Holtec did not use the particular input devices in the display panels from the User's Manual identified by the State but used different input display panels when it developed the EHT model for the HI-STORM 100 at the PFSF.) When the user changes an element of code input data by one of the input devices (to include a relationship or equation to be used by FLUENT to perform its thermal calculations) each input device that controls that element of code input data is automatically updated by the program to reflect the change in the data made by the user. No matter how the data is changed, however, from the various input panels, the input data ultimately used by FLUENT to perform its calculations is indicated in the case file for the code run. Thus, all the data used by Holtec to perform its analysis with the EHT model is present in the case files provided to the State.

9. Specifically, the State requests the "yes-no" and/or numerical choices in various computer screen panels of "decision boxes" (i.e., input devices) for each of the 19 "zones" identified in the input files used for the FLUENT code in the EHT analysis of the HI-STORM 100 at the PFSF site. Letter from D. Curran to W. Hollaway (Dec. 14, 1999). The State's letter attaches 25 such computer screens which it apparently requests for each of the 19 zones, or a total of 475 computer screen panels. Each panel is an organized display of information concerning the FLUENT input data. Each zone represents a sub-region of the physical entity (i.e., the HI-STORM 100 cask) being modeled. Holtec does not, however, maintain in its regular course of business the panel decision boxes requested by the State in hard copy paper format or an accessible electronic format. Rather, the 475 panel decision boxes requested by the State would need to be "backed out" or manually extracted from the computer files at great time and cost, as described in detail below.

10. Further, all of the information used by the FLUENT code to perform its calculations is contained in the "case file" input files, which Holtec has provided to the State through PFS. The case files reflect all the relationships and equations, the geometry of the object(s) being modeled, and all thermophysical properties of the object(s) that were chosen by Holtec for the EHT model and which FLUENT used in performing the calculations for the EHT model. All the data used by FLUENT in Holtec's thermal analysis with the EHT model for the HI-STORM 100 at the PFSF site are reflected in the "case file" input files. The FLUENT code uses the case files to perform its calculations and produce its output data, which indicates the temperatures of the various components of the spent fuel storage cask.

11. As indicated above, a user may employ different devices within FLUENT to create the case files and Holtec did not create its case files using the particular input devices for which the State requests the computer screen images.

Nevertheless, all the data used by Holtec in performing its runs of the EHT model for PFS are present in the case files provided to the State. The input devices for which the State requests the computer screen images do not represent independent bits of information over and above the input data in the FLUENT case files. Thus, in order to duplicate the runs of the FLUENT code Holtec used in the EHT analysis of the HI-STORM 100 at the PFSF site one would only need the case files, not the "decision boxes" (i.e., alternative input devices) for which the State requests the computer screen images.

12. The State asserted in a letter from its counsel to counsel for PFS that while the "factual assumptions" that went into Holtec's EHT analysis of the HI-STORM 100 are contained in the case file input files for FLUENT, the "conceptual assumptions" are only represented by the choices reflected in the decision boxes in the FLUENT User's Manual. Letter from D. Curran to W. Hollaway (Dec. 16, 1999). The State defines the conceptual assumptions as "the selection of various equations and/or conceptual models that were used in the thermal analysis." Id. The State's assertion is wrong. The conceptual assumptions (i.e., the choices of the relationships and equations that FLUENT uses to perform its thermal calculations) are, in fact, reflected in the case file input files that Holtec provided to the State. For example, one display panel, for which the State requests the computer screen image, indicates the status of the "ALLOW HEAT FLUX BOUNDARY CONDITION" for the zones in the model (either "yes" or "no"). The status of that same boundary condition is indicated in the FLUENT case file in the Special Temperature Boundaries section, in the column labeled "HEAT FLUX BOUNDARY." As indicated above, FLUENT does not use any data or operate in any way on the basis of information in the decision boxes that is not reflected in the case files.

13. Moreover, with the User's Manual and the case files, one can determine the equations and relationships that FLUENT uses to perform its calculations. The

case files (in text form, as Holtec provided to the State) are intelligible; the computer screen images of the alternative input devices (i.e., "decision boxes") are not necessary to understand the operation of FLUENT. For example, on the cover page of the case file, the EHT model run condition is indicated in terms of ambient temperature and spent fuel heat load. The following pages provide a comprehensive listing of the units for all the variables (e.g., pressure, temperature, and density) used by the FLUENT code. The geometric data for the EHT model (which describes the geometry of the object modeled, i.e., the cask), the grid information, and nodal positions are indicated in the Geometry section. This is followed by a topographical layout of the entire computational grid structure developed for the EHT model for the HI-STORM 100 cask at the PFSF. All the zones in the model are depicted and accurately reflect their relative positions in the model structure. This is followed by many sections of information concerning the thermophysical properties of all the EHT model zones. These include, e.g., "VELOCITY/PRESSURE BOUNDARY CONDITIONS," "TEMPERATURE BOUNDARY CONDITION," "CONDUCTING WALL ZONE PROPERTIES," "POROUS ZONE PROPERTIES," and "ZONE EMISSIVITIES." This comprehensive array of coherently packaged information defines in-toto the complete EHT model of the HI-STORM 100 spent fuel storage cask at the PFSF.

14. The production of the 475 panels of decision boxes would be unreasonably burdensome for PFS and Holtec. Holtec does maintain in its usual course of business copies of the FLUENT case files, which it has provided to the State. The 475 panels of decision boxes sought by the State, however, are not maintained by Holtec in its usual course of business either separately in paper or readily accessible electronic form. Rather, they must be specially generated individually following a laborious process by someone who is familiar with how the FLUENT code works, such as myself, by manually extracting them from the computer while the case files are loaded into the computer. The extraction process involves

the following stepwise procedure for producing on paper <u>each</u> of the 475 display panels with the decision boxes requested by the State:

a. <u>Step 1</u>: With the FLUENT program running and the electronic modeling databases read in, the user must step through the command structure as described in the User's Manual instructions to access the display panel with the requested decision boxes.

b. <u>Step 2</u>: With the display panel information on the computer screen, the user must start a separate screen capture program to scan the screen video display bitmap. This is necessary because it is not possible to print the screen directly while the FLUENT code is running. The screen capture program enables the screen image of the display panel to be captured and then printed separately.

c. <u>Step 3</u>: The user must save the captured information—the screen video display bitmap—on the computer's hard disk.

d. <u>Step 4</u>: The user must use a separate video editing program to read the saved screen capture information.

e. <u>Step 5</u>: The screen dumps produced by the capturing program contains extraneous information (color graphical images) that may render the information sought by the State illegible when printed. For those display panels for which that is the case, the user will have to edit the video bitmap and clip out the relevant display panel information so that it is not obscured by the display panel graphical images.

f. <u>Step 6</u>: The user must print the captured screen image of the display panel on a high resolution printer.

g. <u>Step 7</u>: The user must proofread the print for visual clarity and correlate and assemble the printed screens in the proper order.

15. Based on my familiarity with the FLUENT code, I estimate that this process will take on average approximately 10 minutes per computer screen display panel requested by the State. Therefore, since the State has requested 475 panels (25 panels for each of 19 zones in the model of the HI-STORM 100), it would take approximately 80 man-hours of a user who is familiar with the operation of the FLUENT code, such as myself, to comply with the State's request, assuming that the user works continuously without interruption. The 80 hours of my time to produce copies of the 475 panels of decision boxes requested by the State would

cost approximately $ 15,000. In addition, the results of my work would need to go through Holtec's normal validation and Quality Assurance (QA) process. Based on Holtec's past experience, such validation and QA would increase this cost estimate by a factor of three to $45,000.

16. This large cost of generating, producing and validating the 475 panels of decision boxes, not maintained as such by Holtec in its usual course of business, is an especially unreasonable burden on Holtec and PFS in that, as indicated above, Holtec (through PFS) has provided the State with all the input data—including the input data reflecting the choices of relationships and equations in FLUENT—in an intelligible form, used in the EHT analysis of the HI-STORM 100. The State's request merely asks for data it has already received to be created and produced in a different form. The requested information is unduly burdensome for Holtec and PFS to produce and unnecessary to perform a competent review of the PFS EHT model. Holtec and PFS should not bear the burden essentially of translating the data already provided into a form of the State's choice. Should the State truly believes that it requires the data in the form requested, it could always acquire the FLUENT code and use the electronic version of the input files provided to it by Holtec and the State to generate the requested pull down decision boxes.

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

Executed on December 20, 1999.

Indresh Rampall

Indresh Rampall

EXHIBIT 1

RESUME

INDRESH RAMPALL, Ph.D.

PRINCIPAL ENGINEER
HOLTEC INTERNATIONAL

EDUCATION

Ph.D. in Chemical Engineering
University of Notre Dame (1992), GPA 3.97/4.0

M.S. in Chemical Engineering
University of Notre Dame (1989), GPA 4.0/4.0

B. Tech in Chemical Engineering
Indian Institute of Technology (1978), Grade A2

PROFESSIONAL EXPERIENCE

HOLTEC INTERNATIONAL

April 1993 - Present **Principal Engineer**

Heat exchange, steam generation and fuel pool cooling system design, licensing and consulting.

CLARKSON UNIVERSITY
Potsdam, NY

September 1992 - April 1993 **Research Associate**

ENGINEERS INDIA LIMITED (EIL)
New Delhi, India

1978 - 1987 **Senior Engineer, Research and Development Department**

A major consultancy and project engineering company in the refineries, petrochemicals and on- and off-shore exploration.

EXPERIENCE SUMMARY

- **Process Design and Development Experience**

  1. **Process design work including Heat and Material Balance Calculations, preparation of Process Flow and P&I Diagrams, Specifications for Process Instruments, Pumps and Equipment (Pressure Vessels, Heat Exchangers, etc.). Also prepared Operations Manuals for start-up, operations, shutdown, emergency procedures and plant safety.**
  2. **Developed process models for design of two-phase flow high pressure pipelines from off-shore platforms.**
  3. **Developed steady state and dynamic process design models of heterogeneous fixed bed catalytic reactors used in refineries and petrochemical plants. The models were used to**

analyze industrial and pilot-plant data for the o-xylene and ethylene oxidation reactors to develop a complete reactor simulation model.

4. **Development of a process design and simulation model for the zeolites based ZSM-5 catalyst used in the xylenes isomerization reactor for a large petrochemical complex. Appointed as the lead process engineer for planning of bench scale experiments at plant site as well as analysis of data to obtain a detailed kinetic model of the process.**

- **Chemical Process Plant Experience**

1. **Appointed as the *lead process engineer* for development of the Ethylene epoxidation technology. Completed the process design, construction supervision and operation of a highly automated, full-scale, single tube, medium pressure, pilot plant for the catalytic oxidation of ethylene to ethylene oxide. Highly experienced with hands-on work involving process instrumentation, continuous on-line analyzers as well as process gas chromatographs. Developed process models from statistical analysis of pilot-plant data to evaluate catalyst/reactor performance.**

2. **Commissioning of a 25 million lbs/yr industrial plant for the production of phthalic anhydride by oxidation of o-xylene. Worked in pre-commissioning activities, preparation for start-up, establishing stable and safe operating conditions and guarantee test runs to meet all process specifications for yield and purity of products.**

PhD Thesis Title and Summary of Research

Shear induced structure and migration in non-colloidal suspensions

1. ***Experimental determination of the pair distribution function for a suspension of spheres in simple shear flow***

   A new direct flow visualization technique, employing a thin sheet of laser light, is developed for imaging the interior of suspensions. This is combined with a novel pattern recognition algorithm to simultaneously locate the position and size of particles in a dynamic cross-section of a suspension of 3 mm acrylic spheres sheared in a flow visualization apparatus. Fundamental information on the nature of particle interactions and the suspension micro-structure is obtained. In addition to direct applications in predicting rheological properties of the suspension such as the bulk viscosity, we also gain insight into the more complex phenomena such as normal stress differences, anisotropy, particle migration, etc.

2. *The influence of shear induced migration on turbulent resuspension*

A new model is proposed to predict the condition when particles are first ejected from the viscous sub-layer of a fluid flowing over a settled layer of particles into the turbulent core of the fluid. The resuspension process is modelled in terms of a set of non-linear integro-differential convection-diffusion equations with moving singular boundaries. The equations are discretized and solved as a large set of *dense* differential and algebraic equations using the DASSL solver on the Convex mini-supercomputer.

Important Applications of PhD Research

- Knowledge of the micro-structure (i.e., the local arrangement and orientation of particles) has important applications in the area of Rheology of Suspensions and mechanical properties of Filled Polymer Composites. The bulk properties of the suspension such as effective viscosity, thermal and electrical conductivities are strongly influenced by this local distribution of particles.

- In the area of Multi-Phase Flow, the resuspension and transport of an initially settled bed of particles due to turbulent flow of fluid is solved. This work has applications in viscous systems such as flow of coal-oil slurry or drilling muds.

- Solved the mass transfer due to turbulent eddies near a wall in sedimenting systems. The model is applicable for the analysis of the improved performance of cross-flow microfiltration of suspended particles as well as in ultrafiltration of large molecular species. Increased mass fluxes can be obtained due to an induced secondary eddy flow in the near wall region.

Computational Experience

Developed programs in Fortran and C for solving complex engineering problems using advanced numerical techniques on a variety of hardwares - IBM, Vax, Convex, and Sun workstations - and operating systems - DOS, VAX/VMS, Unix, etc.

Supercomputer Training

Undertaken special training programs to take advantage of the Convex vectorization support in Fortran. Familiar with programming techniques on the massively parallel Connection Machine.

Patent

An improved process scheme for production of phthalic anhydride by oxidation of o-xylene in multistage reaction systems, by I. Rampall, A. Datta and P.K. Mukhopadhayay, Patent application in India (submitted).

PUBLICATIONS

1. *Measurement of the shear-induced microstructure of concentrated suspensions of non-colloidal spheres*, by D.T. Leighton and I. Rampall, Review paper in "Particulate Two-Phase Flow", M. Roco (editor), Butterworths, (1993).

2. *The influence of shear induced migration on turbulent resuspension*, by I. Rampall and D.T. Leighton, Submitted to the Int. J. of Multiphase Flow, (1992).

3. *The influence of surface roughness on the pair-particle distribution function in dilute suspensions of non-colloidal spheres in simple shear flow*, by I. Rampall, J.R. Smart, D.T. Leighton, Submitted to the Journal of Fluid Mechanics, (1992).

4. *Studies in reactor configuration for phthalic anhydride production*, by I. Rampall, A. Datta and P.K. Mukhopadhayay, "Frontiers in Chemical Reaction Engineering", vol. II, L.K. Doraiswamy and R.A. Mashelksar (Editors), 241-258, John Wiley and Sons, (1984).

5. *Parameter estimation and simulation of multi-tubular ethylene oxide reactor*, by R. Aggarwal, I. Rampall and A. Datta, "Recent Trends in Chemical Reaction Engineering", vol. II, B.D. Kulkarni, R.A. Mashelkar and M.M. Sharma (Editors), 360-374, Wiley Eastern, (1987).

PRESENTATIONS

1. *Flow driven by oscillatory gravitational fields in a vertical channel wall effects*, by I. Rampall and R. Shankar Subramanian, First international workshop on g-jitter, Clarkson University, Potsdam, NY (June 13-18, 1993).

2. *A direct flow visualization method to study the shear-induced microstructure of non-colloidal suspensions*, by I. Rampall, Invited seminar talk at Clarkson University, Potsdam, NY (1993).

3. *Particle dynamics near a solid wall in concentrated suspensions of non-colloidal spheres*, by G. Krishnan, I. Rampall and D.T. Leighton, Presented at the AIChE Annual meeting in Miami, FL (1992).

4. *The influence of shear induced migration on turbulent resuspension*, by I. Rampall and D.T. Leighton, Presented at the AIChE Annual meeting in Los Angeles, CA (1991).

5. *On the pair-particle distribution function in dilute suspensions of non-colloidal spheres in simple shear flow*, by I. Rampall, J.R. Smart and D.T. Leighton, Paper presented at the AIChE Annual meeting in Chicago (1990).