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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Before the Atomic Safety and Licensing Board

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

**APPLICANT'S MOTION FOR SUMMARY DISPOSITION OF UTAH CONTENTION GG – FAILURE TO DEMONSTRATE CASK-PAD STABILITY DURING SEISMIC EVENT FOR TRANSTOR CASKS**

Applicant Private Fuel Storage L.L.C. ("Applicant" or "PFS") files this motion for summary disposition of "Utah Contention GG – Failure to Demonstrate Cask-Pad Stability During Seismic Event for TranStor Casks," ("State's Contention") pursuant to 10 C.F.R. § 2.749. Summary disposition is warranted on the grounds that there exists no genuine issue as to any material fact relevant to the contention and, under applicable Commission regulations, PFS is entitled to a decision as a matter of law. This motion is supported by a Statement of Material Facts, to which the Applicant asserts no genuine dispute exists, and the declaration of Dr. Alan Soler ("Soler Dec.") and related exhibits.

## I. STATEMENT OF THE ISSUES

On April 22, 1998, the Atomic Safety and Licensing Board ("Licensing Board" or "Board") admitted Contention Utah GG. Private Fuel Storage, L.L.C. (Independent

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Spent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 210 (1998). The contention, as admitted, asserts that:

> The Applicant has failed to demonstrate that the TranStor storage casks and the pads will remain stable during a seismic event, and thus, the application does not satisfy 10 C.F.R. §§ 72.122(b)(2) and 72.128(a), in that Sierra Nuclear's consultant, Advent Engineering Services, Inc., used a non-conservative "nonsliding cask" tipover analysis that did not consider that the coefficient of friction may vary over the surface of the pad and did not consider the shift from the static case to the kinetic case when considering momentum of the moving casks.

Id. at 257. The Board refused to admit any other bases for the State's Contention, including the alleged inadequacy of the "consideration [given] to site-specific soil characteristics," and the allegedly insufficient information on soil characteristics provided for input to the analysis. Private Fuel Storage, LLC (Interim Spent Fuel Storage Installation), 47 NRC 142, 210-11 (1998). Thus, the State's Contention is limited to the contention that PFS "used a non-conservative 'nonsliding cask' tipover analysis" by not considering (1) "that the coefficient of friction may vary over the surface of the pad" and (2) that the value of the coefficient of friction may be reduced under the dynamic conditions of an earthquake by virtue of having "shift[ed] from the static case to the kinetic case," such that sliding of the casks could occur with potential momentum impacts.[1] Id. at 257.

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[1] Contrary to any potential assertion by the State, the second aspect of Utah GG ("the shift from the static case to the kinetic case") only concerns the coefficient of friction. Like the first issue, the second issue is taken directly from the bases paragraph of the contention which focuses solely on the coefficient of friction used in the cask stability analysis. This paragraph in substantive part states as follows:

> [A] factor not considered by . . . Advent Engineering Services, Inc., who evaluated the tipover analysis using the horizontal seismic forces, is that the coefficient of friction may vary over the surface of the pad. . . . . However, the coefficient of friction, which is larger when the casks are static, may also reduce under dynamic conditions of an earthquake.

The Applicant moves for summary disposition of the State's Contention on the grounds that it is now moot. On September 23, 1999, PFS submitted a revised analysis of the stability of the TranStor cask during a seismic event to the Nuclear Regulatory Commission ("NRC"). See "PFSF Site-Specific Cask Stability Analysis for the TranStor Storage Casks," (September 23, 1999) (Exhibit 2 to Declaration of Dr. Alan Soler) (hereinafter "TranStor Analysis"). As explained below, the revised analysis explicitly address the State's concerns by performing the cask stability analysis for both a conservatively high and conservatively low coefficient of friction such that the potential effects of both cask tipover and sliding (including accounting for any momentum effects should an impact occur) are evaluated. The analyzed coefficients of friction bracket all reasonably expected values from the interaction of a steel-bottomed cask with a concrete pad, including those due to the shift from the static case to the kinetic case as well as surface variations. Thus, no genuine issue of material fact remains under the State's Contention, and PFS is entitled to a decision as a matter of law.

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> Advent Engineering did not consider the shift from the static case to the kinetic case when considering the momentum of the moving casks.

State of Utah's Request for Consideration of Late-Filed Contention GG, at 7-8 (emphasis added) (footnote omitted). Late-Filed Contention GG at 7-8. In addition, as reflected in the above quotation, the assertion that Advent "did not consider the shift from the static case to the kinetic case" directly follows the statement that "the coefficient of friction . . . may also reduce under dynamic conditions of an earthquake." Id. at 8 (emphasis added). Given the context of the supporting basis, there can be no doubt that both issues are limited to the coefficient of friction, with the second concerning the alleged failure to consider that the value of the coefficient of friction may be reduced under the dynamic conditions of an earthquake by virtue of having "shift[ed] from the static case to the kinetic case" such that sliding would occur. See Soler Dec. at ¶ 6.

## II. LEGAL BASIS FOR SUMMARY DISPOSITION

Pursuant to Commission regulations, a party is entitled to summary disposition "as to all or any part of the matters involved in [a] proceeding," "if the filings in the proceeding, depositions, answers to interrogatories, and admissions on file, together with the statements of the parties and the affidavits [provided], if any, show that there is no genuine issue as to any material fact and that the . . . party is entitled to a decision as a matter of law." 10 C.F.R. § 2.749. PFS set forth the relevant law at some length in its first motion for summary disposition, and the legal basis for summary disposition provided in that motion is incorporated by reference herein. See Applicant's Motion for Summary Disposition of Utah C at 3-15 (April 21, 1999).

The State may file affidavits purporting to contain expert opinion in opposition to this motion and therefore the legal requirements concerning such, id. at 10-15, will be particularly relevant here. These requirements include 1) demonstration of the affiant as an expert,[2] and 2) an explanation of facts and reasons in the affidavit supporting the affiant's expert's opinion.[3] An affidavit made on "information and belief" is insufficient,[4] as are mere unsupported conclusions.[5] As the Supreme Court has held, reliable expert

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[2] Sullivan v. Rowan Cos., 952 F.2d 141, 144 & n.6 (5th Cir. 1992). A licensing board will determine an affiant's qualifications under Rule 702 of the Federal Rules of Evidence. Florida Power & Light Company (Turkey Point Nuclear Generating Plant, Units 3 and 4), ALAB-950, 33 NRC 492, 501 n.5 (1991).

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

[4] Columbia Pictures Industries, Inc. v. Professional Real Estate Investors, Inc., 944 F.2d 1525, 1529 (9th Cir. 1991), aff'd on other grounds, 508 U.S. 49 (1993).

[5] Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), LBP-83-32A, 17 NRC 1170, 1177 (1983).

opinion must be based on "more than subjective belief or unsupported speculation." Daubert v. Merrell Dow Pharmas., Inc., 509 U.S. 579, 590 (1993). The Applicant asks the Board to carefully examine both the qualifications of any witnesses proffered by the State and the bases for any purported expert opinion to ensure that unqualified, unsupported testimony is not considered.

## III. PFS IS ENTITLED TO SUMMARY DISPOSITION OF UTAH GG

PFS is entitled to summary disposition because no genuine issue of material facts exists. Specifically, PFS's revised cask stability analysis for the TranStor cask effectively considers both variations in the coefficients of friction over the surface of the pad, as well as the shift from the static case to the kinetic case, the two issues that form the basis of Utah GG. Where a contention is rendered moot by events occurring after its admission, summary disposition is warranted.[6]

Under 10 C.F.R. § 72.122, an applicant for an ISFSI license must, inter alia, ensure that structures, systems and components ("SSCs") important to safety are designed to withstand the effects of natural phenomena, including earthquakes. Based on the original cask pad stability analysis performed by Advent Engineering Services ("Advent"), the State alleged that PFS failed to satisfy this requirement because Advent had used a "non-conservative 'nonsliding cask' tipover analysis" by not considering that the coefficient of friction may vary over the surface of the pad and may shift from the static to the kinetic case, i.e., slide when considering potential momentum effects of the casks.

[6] See Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), CLI-92-8, 35 NRC 145, 154 (1992); Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-945, 33 NRC 175, 177 (1991).

LBP-98-7, 47 NRC at 210 (emphasis added). Advent had assumed that the cask edge was analytically pinned to the pad – and thus the cask could not slide – in order to conservatively favor the tendency of the cask to tip over. See "Safety Analysis Report for the TranStor Storage Cask System," rev. B, at 11-25; Soler Dec. at ¶¶ 4 & 6.

The issues raised by the State are now moot because PFS has submitted a revised analysis that directly addresses the bases for the State's concerns.[7] See Soler Dec. at ¶¶ 9-12. The new analysis of the TranStor cask was performed by Holtec International using the same methodology employed by Holtec in May 1997,[8] August 1999,[9] and August 1999[10] to analyze the stability of the Hi-Storm 100 cask at the PFS Facility. Id. at ¶ 8.

Rather than analyze cask stability at every potential coefficient of friction, Holtec instead evaluated cask stability for both a conservatively high value and a conservatively low value for the coefficient of friction. See Soler Dec. at ¶¶ 9-10; see also, TranStor Analysis at 9-10. For each value, Holtec analyzed both the likelihood of tipover and the possibility of cask contact due to sliding. Soler Dec. at ¶¶ 9 & 11. The conservatively high coefficient of friction had a value of 0.8. Id. at ¶¶ 9-10. This value is greater than the coefficient of friction between steel-concrete interfaces that could reasonably be expected to occur and thus bounds the highest coefficient of friction expected to occur. Id.

[7] To date, three months after having been sent the revised TranStor analysis (Soler Dec. at ¶ 2), the State has not filed any contentions concerning the revised analysis.

[8] "Multi-cask Response at the PFS ISFSI," HI-971631, Rev. 0 (May 1997) (analyzing the deterministic design earthquake).

[9] "Seismic Response of Casks at the PFS ISFSI from 1000 Year Return Seismic Event," HI-992242, Rev.1 (August 1999).

[10] "Seismic Response of Casks at the PFS ISFSI from 2000 Year Seismic Event," HI-992277 (August 1999).

at. ¶ 10. The use of a conservatively high value for the coefficient of friction exaggerates the potential for cask tipover. Soler Dec. at ¶¶ 9 & 11.

The conservatively low coefficient of friction used in the TranStor Analysis had a value of 0.2. Id. at ¶¶ 9-10. This value is lower than the coefficient of friction between steel-concrete interfaces that could reasonably be expected to occur and thus bounds the lowest coefficient of friction expected to occur. Id. at. ¶ 10. The use of a conservatively low coefficient of friction emphasizes cask sliding, increasing the likelihood of cask-to-cask impact. Id. at ¶¶ 9 & 11. If a cask-to-cask impact were to occur, the Holtec analysis would take into account the momentum of the casks when determining the potential effects of the cask contact. Id. at ¶ 9.

Holtec's analysis of the stability of the TranStor casks resolves the issues contested by the State in Utah GG. First, the TranStor Analysis addresses the State's concern that PFS failed to evaluate sliding of the casks by placing no restraints on the movement of the casks and allowing them to slide in response to the seismic forces. Id. at ¶ 12; see also id. at 9 & 11. Because the casks are free to slide, the State's concern that PFS relies on a "'nonsliding cask' tipover analysis" is no longer valid. Id. Second, the broad range of coefficients of frictions encompassed by the conservatively high and low values analyzed in the TranStor Analysis bound any variations in the coefficient of friction over the surface of the pad. Id. at ¶¶ 10 & 12. Third, the effect of the reduction of the coefficient of friction due to the "shift from the static case to the kinetic case" is considered by the analysis of cask stability at the lower coefficient of friction. The lower coefficient of

friction of 0.2 is less than any reduction of the coefficient of friction due to the dynamic conditions of an earthquake, resulting in the conservative estimation of the effects of sliding for the kinetic case. Id. at ¶ 12.

Because the coefficients of friction analyzed in the TranStor Analysis bound all reasonably expected values for a concrete-steel interface, including any reduction due to a shift from the static case and the kinetic case, or variations over the surface of the pad, the State's concerns set forth in Contention Utah GG are now moot.

## IV. CONCLUSION

Because PFS's revised analysis considers the effect on the coefficient of friction from surface variations over the pad and the shift from the static case to the kinetic case, the State's contention is moot and, thus, the Board should grant the Applicant summary disposition with respect to Contention Utah GG.

Respectfully submitted,

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Paul A. Gaukler
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Counsel for Private Fuel Storage L.L.C.

Dated: December 30, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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## STATEMENT OF MATERIAL FACTS ON WHICH NO GENUINE DISPUTE EXISTS

The Applicant submits, in support of its motion for summary disposition of Contention Utah GG, this statement of material facts as to which the Applicant contends that there is no genuine issue to be heard.

1. On January 8, 1998, the State of Utah filed as part of its contentions, Contention Utah GG, challenging the adequacy of PFS's calculation of TranStor cask stability.

2. In its Memorandum and Order of April 22, 1998, LBP-98-7, the Licensing Board admitted Contention Utah GG in part as follows:

> The Applicant has failed to demonstrate that the TranStor storage casks and the pads will remain stable during a seismic event, and thus, the application does not satisfy 10 C.F.R. §§ 72.122(b)(2) and 72.128(a), in that Sierra Nuclear's consultant, Advent Engineering Services, Inc., used a nonconservative "nonsliding cask" tipover analysis that did not consider that the coefficient of friction may vary over the surface of the pad and did not consider the shift from the static case to the kinetic case when considering momentum of the moving casks.

3. In its original analysis of the TranStor cask stability, PFS's consultant, Advent Engineering Services, had assumed that the cask was analytically pinned at one edge, which did not allow for the sliding of the cask. Soler Dec. at ¶¶ 4 & 6.

4. On September 23, 1999, PFS submitted its revised analysis, the "PFSF Site-Specific Cask Stability Analysis for the TranStor Storage Casks," HI-992295, to the NRC. Soler Dec. at ¶ 2.

5. In its revised analysis for PFS, Holtec analyzed the potential for cask tipover and cask-to-cask impact for the design basis seismic event using two different coefficients of friction. Soler Dec. at ¶ 9.

6. The value of the lower coefficient of friction analyzed by Holtec is 0.2. Soler Dec. at ¶ 9.

7. The value of 0.2 is lower than the coefficient of friction between steel-concrete interfaces that could reasonably be expected to occur and thus bounds the lowest coefficient of friction expected to occur. Soler Dec. at ¶ 10.

8. The analysis at a coefficient of friction of 0.2 emphasizes the possibility of cask sliding and ensures that the potential effect of sliding, including accounting for any momentum effects should an impact occur, is evaluated. Soler Dec. at ¶¶ 9 & 11.

9. The value of the higher coefficient of friction analyzed by Holtec is 0.8. Soler Dec. at ¶ 9.

10. The value of 0.8 is greater than the coefficient of friction between steel-concrete interfaces that could reasonably be expected to occur and thus bounds the highest coefficient of friction expected to occur. Soler Dec. at ¶ 10.

11. The two coefficients of friction analyzed effectively bracket any variations in the coefficient of friction over the surface of the pad. Soler Dec. at ¶¶ 10 & 12.

12. The lower coefficient of friction of 0.2 analyzed by Holtec is less than any coefficient of friction that could reasonably be expected to occur between the cask and the pad due to the shift from the static case to the kinetic case resulting from the dynamic conditions of an earthquake. Soler Dec. at ¶¶ 10 & 12.

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| | ) | |
| (Private Fuel Storage Facility) | ) | ASLBP No. 97-732-02-ISFSI |

## DECLARATION OF DR. ALAN SOLER

Dr. Alan Soler states as follows under penalties of perjury:

1. I am an Executive Vice-President with Holtec International ("Holtec"). Holtec is a vendor of storage casks for the Private Fuel Storage Facility ("PFSF"). My professional and educational experience is summarized in the resume attached as Exhibit 1 of this declaration.

2. In my capacity as Executive Vice-President for Holtec, I oversaw and am responsible for the revised analysis of the cask stability of the TranStor cask during the design basis seismic event entitled, "PFSF Site-Specific Cask Stability Analysis for the TranStor Storage Casks," HI-992295. (Exhibit 2 to this Declaration.) This analysis was submitted to the NRC on September 23, 1999, and transmitted to the State on September 30, 1999. I am also familiar with Utah Contention GG raised by the State of Utah in the NRC licensing hearing for the PFSF.

3. Prior to my current employment with Holtec International, I was a Professor of Mechanical Engineering and Applied Mechanics at the University of Pennsylvania. As an Assistant, Associate, and full Professor over a 26 year period, I taught graduate and undergraduate courses in mechanical engineering, engaged in funded research, and was an active consultant to industry on various mechanical engineering matters.

4. In the initial License Application for the PFSF, dated June 20, 1997, PFS concluded that the TranStor cask would remain stable during the site specific deterministic design earthquake. PFS based this conclusion on the analysis performed by Advent Engineering Services, Inc. The analysis by Advent assumed that the cask was analytically pinned at one edge and therefore the coefficient of friction between steel and concrete was not considered.

5. I have reviewed Contention Utah GG as well as the State's basis underlying the contention. In Utah GG, the State claims that PFS "used a non-conservative 'nonsliding cask' tipover analysis that did not consider that the coefficient of friction may vary over the surface of the pad, and did not consider the shift from the static case to the kinetic case when considering momentum of the moving casks." In the basis for the contention, the State similarly claims that a "factor not considered by . . . Advent Engineering Services, Inc., who evaluated the tipover analysis using the horizontal seismic forces, is that the coefficient of friction may vary over the surface of the pad. . . . . However, the coefficient of friction, which is larger when the casks are static, may also reduce under dynamic conditions of an earthquake. Advent Engineering did not consider the shift from the static case to the kinetic case when considering the momentum of the moving casks." State of Utah's Request for Consideration of Late-Filed Contention GG, at 7-8 (footnote omitted).

6. Based on the language of the Contention and its stated basis, the subject of Utah GG is the value of the coefficient of friction used, or not used, in the analysis, including the potential shift from a static value for the coefficient of friction to a dynamic value. Specifically, contention Utah GG was made with respect to the initial cask stability analysis performed for the TranStor cask by Advent Engineering. Advent's approach conservatively favors the tendency of a cask to tipover because all of the applied force acts to tipover the cask and no force is expended to overcome the frictional force. Because the coefficient of friction was not considered in this analysis, variations in the coefficient of friction and the shift in the coefficient of friction from the static case to

the kinetic case, i.e., sliding, were not relevant. Utah GG challenges the adequacy of the "nonsliding cask" tipover analysis performed by Advent. The revised analysis contained in the "PFSF Site-Specific Cask Stability Analysis for the TranStor Storage Casks," HI-992295, addresses these coefficient of friction issues raised in Utah GG.

7. The "coefficient of friction" is a measure of the intensity of the resistance to movement of contacting surfaces. The value of the coefficient of friction is dependent on the characteristics of the two materials at the interface contact point and also whether the materials are in motion, relative to each other, along a direction parallel to the interface surface. The coefficient of friction between two materials at rest at the interface contact point, i.e. the static case, may be slightly more than for the same materials in relative motion, i.e., the kinetic case. The coefficient of friction shifts from the static case to the kinetic case upon the initiation of relative movement.

8. To analyze the stability of the TranStor storage cask, Holtec employed the same methodology used in the analysis of the Hi-Storm 100 storage cask submitted as part of PFS's initial license application filed on June 20, 1997, and used in two subsequent cask stability analysis, the "Seismic Response of Casks at the PFS ISFSI from 1000 Year Return Seismic Event," HI-992242, Rev.1 (August 1999) and the "Seismic Response of Casks at the PFS ISFSI from 2000 Year Seismic Event," HI-992277 (August 1999). Under the analytical model, the storage cask is free to slide and impact other casks, as well as to tipover.

9. In its analysis of the TranStor storage cask, Holtec evaluated the potential for cask tipover and cask-to-cask impact for the design basis seismic event by analyzing cask stability at two coefficients of friction. The analysis at the lower coefficient of friction of 0.2 emphasizes the potential of the cask sliding on the concrete pad, and would account for any momentum effects should an impact occur. The analysis at the higher coefficient of friction of 0.8 emphasizes the possibility of cask tipover.

10. The chosen values of 0.2 and 0.8 effectively bracket the expected range of the coefficient of friction for the interaction of a steel-bottomed cask with a concrete pad. Typical upper and lower bounds for the static coefficient of friction given by various handbooks for metal on concrete/stone surfaces range between 0.3 to 0.7. See, e.g., Mark's Standard Handbook for Mechanical Engineers 3-22 (Eugene A. Avallone & Theodore Baumeister, III, eds., 10th ed. 1997) (coefficient of friction for iron on stone – 0.3 to 0.7); Harry Parker and James Ambrose, Simplified Mechanics and Strength of Materials 34 (5th ed. 1992) (coefficient of friction for metal on stone, masonry, or concrete – 0.3 to 0.7). Kent's Mechanical Engineering Handbook 7-28 (C. Carmichael, ed., 12th ed. 1965) (coefficient of friction for steel on stone – 0.420 to 0.491). The value for the kinetic coefficient of friction will be slightly less than these values. The value of the lower coefficient of friction analyzed by Holtec of 0.2 is less than the lower bounds from these handbooks. The value of the higher coefficient of friction analyzed by Holtec of 0.8 is greater than the upper bounds from these handbooks.

11. Because a cask has a greater potential to slide as the coefficient of friction is decreased, the analysis of the cask stability at the lower coefficient of friction is more likely to result in sliding. Correspondingly, as the coefficient of friction is increased, a storage cask becomes more likely to tipover instead of sliding. By analyzing high and low coefficients of friction, Holtec's analysis ensures that the potential effects of both cask tipover and sliding are evaluated.

12. Holtec's analysis of the stability of the TranStor casks resolves the issues contested by the State in Utah GG. First, the analysis addresses the State's concern with the "'nonsliding cask' tipover analysis" by allowing the casks to slide. Because no restraints are placed on the movement of the casks, the analysis evaluates the potential for both sliding and tipover. Second, by analyzing two coefficients of friction that bracket reasonably expected values, the revised analysis considers the effect of the coefficient of friction varying over the surface of the pad. Any variation in the coefficient of friction will be within the range analyzed, and any sliding or tipping will be less than that

determined by Holtec. Third, the effect of the reduction of the coefficient of friction due to the "shift from the static case to the kinetic case" is considered by the analysis of cask stability at the lower coefficient of friction. Because the lower coefficient of friction of 0.2 is less than any reduction of the coefficient of friction due to the dynamic conditions of an earthquake, the revised analysis of the TranStor cask conservatively estimates the effects of sliding for the kinetic case.

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

Executed on December 30, 1999.

Dr. Alan Soler

# EXHIBIT 1

To December 30, 1999
Declaration of Dr. Alan Soler

**ALAN I. SOLER, Ph.D.**

**EXECUTIVE ENGINEER**
**HOLTEC INTERNATIONAL**

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## EDUCATION

University of Pennsylvania
Ph.D. in Mechanical Engineering (1962)

California Institute of Technology
M.S. in Mechanical Engineering (1959)

University of Pennsylvania
B.S. in Mechanical Engineering (1958)

## AREAS OF PROFESSIONAL CONCENTRATION

Dynamics of casks and fuel racks, impact, mechanical design of cask and MPCs, failure analysis of reinforced concrete structures, cask transporter design, NUREG-0612 compliance, crane design and stress analysis.

## PROFESSIONAL EXPERIENCE

**HOLTEC INTERNATIONAL**
Marlton, New Jersey
1986 – Present — Executive Engineer

**UNIVERSITY OF PENNSYLVANIA**
Philadelphia, Pennsylvania
1966 - 1991 — Professor of Mechanical Engineering and Applied Mechanics

**INGERSOLL-RAND RESEARCH CENTER**
Princeton, New Jersey
May 1964–Sept. 1965 — Member of Technical Staff

**DYNASTRUCTURES, INC., CONSULTANTS IN APPLIED MECHANICS**
Philadelphia, Pennsylvania
May 1962–May 1964 — Research Specialist

## ACADEMIC HONORS

Tau Beta Pi
Sigma Tau
Society of Sigma Xi

## PROFESSIONAL SOCIETY MEMBERSHIPS/ACTIVITIES

Member, ASME, Fellow ASME, 1986
Treasurer, University of Pennsylvania Chapter, Sigma Xi, 1968-70.
General Arrangements Committee Member, 1969, ASME Vibrations Conference.
ASEE Local Activity Coordinator, 1968-1974.

Member, Rotordynamics Subcommittee, ASME Design Division, 1973-1974.
Local Arrangements Committee, 1971 Summer ASME Applied Mechanics Meeting.
Recording Secretary, ASME Applied Mechanics Division, Publication Committee, 1971-1972.
-Applied Mechanics Representative to ASME Power Division Subcommittee on Environmental Policy, 1974-1976.
Member, Turbine and Auxiliaries Committee, ASME Power Division, 1974-76, Papers Review
Member, Task Group on Heat Transfer Equipment, ASME, working group #1 (tubesheets), 1975-1998.
Member - Subcommittee on Pressure Vessels and Piping, Nuclear Engineering Division, ASME, 1976-1987, Chairman, 1984-1987.

## TECHNICAL CONSULTING

Consultant to Solid Mechanics Group, Ingersoll-Rand Research Center, Princeton, New Jersey, September 1965 - December 1966.
Consultant to Condenser Engineering Department, Ingersoll-Rand Corporation, Phillipsburg, New Jersey, September 1965 – 1982. Consultant to Structural Mechanics Associates, November 1958 - January 1969.
Visiting Scientist, Mechanical Engineering Research Division, Livermore Laboratories, Livermore, CA, Summer 1973, 1974 (AEC "Q" Clearance).
Member of Consulting Group, Thermac Associates, 1975 - 1986.
Consultant to Joseph Oat Corp. - Manufacturers of Nuclear Heat Exchangers. Camden, New Jersey, 1975 - 1986.
Consultant to Heat Exchange Institute - Nuclear HEX, 1978-1979.
Consultant, Inc., Wilson Div., Reading, PA, 1979-1980.
Consultant, NADC, Willow Grove, PA, 1984-1986.

## PATENTS

Patent #3,382,918, May 1968, Reinforcing Structure for Direct Flow Steam Dome for Condensers (with Mr. R. J. Stoker and Dr. B. Paul of Ingersoll-Rand Corporation).

## DRY SPENT FUEL STORAGE TECHNOLOGY

1992-Present: Lead Analyst in Mechanical/Seismic/Structural analysis in support of Holtec=s Dry Storage submittals for dual-purpose casks (HI-STAR 100 for Storage and Transport) and for METCON casks (HI-STORM 100 for Storage).

1994: Performed cask tip-over and drop analysis to support §50.59 effort for defueling Shoreham Station using IF-300 casks.

1995: Principal Analyst for evaluating cask drop events for Connecticut Yankee.

1997: Co-developer of the dynamic formalism to predict peak cask deceleration from cask tip-over and drop event on ISFSI pads.

1996: Principal designer of HI-STAR 100 Impact Limiter.

1998: Developer of the "penetration area principle" to predict impact limiter response under cask drop events; method was verified using quarter-scale tests.

1999: Designer and principal analyst for Holtec International's autonomous "Cask Transfer Facility" (CTF).

## HIGH DENSITY FUEL RACK STRESS ANALYSIS

- Principal developer of Holtec's rack dynamic analysis code DYNARACK. This code is widely recognized as the most sophisticated program for high density rack seismic analysis.
- Performed seismic analysis of high density racks for 36 Nuclear Power Plants in the period 1980 to present.
- Pioneered dynamic analysis techniques of elevated pool slabs. Qualified the elevated pool slabs of Quad City Units 1 and 2, Grand Gulf and Oyster Creek using dynamic reinforced concrete analysis (all approved by the USNRC).

## LICENSING SUPPORT

- Provided licensing support on over forty high-density rack applications to the USNRC (in the past twenty years).
- Appeared as expert witness (support) for Pacific Gas & Electric in Diablo Canyon reracking license review (1987).

## PUBLICATIONS/PRESENTATIONS

1. "On the Lobar and Longitudinal Vibrations of Solid Propellant Rocket Motors", (with H. B. Kingsbury and J. R. Vinson) Proceedings of the 6th Solid Propellant Rocket Conference, AIAA, Washington, D.C. (February 1965).
2. "On the Solution to Transient Coupled Thermoelastic Problems by Perturbation Techniques", (with M. A. Brull) presented at the Summer Applied Mechanics Meeting of ASME (June 1965) and published in the Journal of Applied Mechanics (June 1965).
3. "A New Perturbation Technique for Differential Equations with Small Parameters", (with M. A. Brull), Quarterly of Applied Mathematics XXIV, No. 2 (July 1966) and presented at the 5th National Congress on Applied Mechanics, Minneapolis, Minnesota (June 1966).
4. "On Rolling Contact and the Theorem of Angular Momentum", (with S. C. Batterman), Journal of Engineering Education 67, 9 (May 1967).
5. "Higher Order Effects in Thick Rectangular Beams", International Journal of Solids and Structures 4, (July 1968) pp. 723-739.
6. "On the Vibrations and Stability of Moving Bands", Journal of the Franklin Institute (October 1968).
7. "Higher Order Theories for Structural Analysis Using Legendre Polynomial Expansions", presented at ASME Winter Annual Meeting, Los Angeles, CA (November 1969), and published in Journal of Applied Mechanics (December 1969).

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

## CERTIFICATE OF SERVICE

I hereby certify that copies of the "Applicant's Motion for Summary Disposition of Utah Contention GG – Utah Contention GG – Failure to Demonstrate Cask-Pad Stability During Seismic Event for TranStor Casks" and "Statement of Material Facts on Which No Material Dispute Exists," dated December 30, 1999, and supporting Declaration from Alan Soler together with Exhibit 1 to the Declaration of Alan Soler were served on the persons listed below (unless otherwise noted) by e-mail, with conforming copies by U.S. Mail, first class, postage prepaid, this 30th day of December, 1999. I further certify that Exhibit 2 to the declaration of Alan Soler, which is a proprietary Holtec report, was served on the Board, the Secretary of the Commission, and lead counsel for the NRC Staff and the State such that receipt will occur the next business day.

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