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)	)	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.

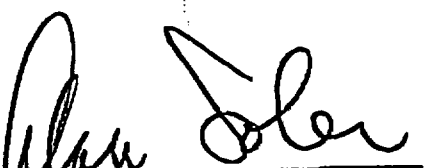
11. Because a cask has a greater potential to slide as the coefficient of friction is decreased, the analysis of the cask stability at the lower coefficient of friction is more likely to result in sliding. Correspondingly, as the coefficient of friction is increased, a storage cask becomes more likely 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

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).

8. "One Dimensional Viscous Magnetofluidynamic Flow in an Annulus", (with S. Schwietzer), presented at the AIAA Fluid and Plasma Dynamics Conference, San Francisco, California (June 1969), and published in Journal of the Franklin Institute 289, No. 6 (June 1970).

9. "On the Solution of Finite Deformation Problems of Beams Using Rate Equations", (with J. Lehner), Journal of Applied Mechanics, (March 1970) pp. 207-210.

10. "Approximate Theory for Locally Loaded Plant Orthotropic Beams", (with H. Tsai), International Journal of Solids and Structures 6, (1970) pp. 1055-1068.

11. "Approximate Solution of the Finite Cylinder Problem Using Legendre Polynomials'< (with J. Fellers), AIAA Journal 8, No. 11 (November 1970) and presented at the 6th U.S. Congress on Applied Mechanics (June 1970).

12. "On Analysis of Cable Network Systems Using Galerkin's Method", (with H. Afshari), Journal of Applied Mechanics, (September 1970) pp. 606-612.

13. "On the Buckling of Rings", (with S. C. Batterman), ASCE Engineering Mechanics Journal (December 1970).

14. "Dynamic Response of Sincle Cables with Initial Sag", Journal of the Franklin Institute (October 1970).

15. "Analysis of Cable Dynamics and Optimum Towing Strategies for Tethered Submersibles", (with B. Paul), presented at the Ocean Engineering Symposium, University of Pennsylvania (November 19-20, 1970), and published in Journal of Marine Technology 6, 2 (April 1972) pp. 34-41.

16. "Circumferential Forces and Moments in Edge Loaded Conical Shell Elements", Journal of Applied Mechanics (March 1972) pp. 290-291.

17. "Pre-twisted Curved Beams of Thin-Walled Open Section", Journal of Applied Mechanics (September 1972) pp. 779-786.

18. "Thermal Stresses and Initial Deformation of Heated Condenser Tubes", Journal of Engineering for Power (April 1973) pp. 84-91.

19. "New Results on Applications of Multi-Segment Stepwise Integration to First Order Equations", (with G. J. Hutchins), Journal of Computer Methods in Applied Mechanics and Engineering (1972) pp. 307-316.

20. "Dynamics of Cables and Cable Systems", Shock and Vibration Digest 5, 3 (March 1973) pp. 1-9.

21. "Cable Network Vibrations Using Galerkin's Method of Polynomial Approximating Functions", (with H. Afshari), Journal of Applied Mechanics (June 1973) pp. 622-624.

22. "Analysis of Moderately Thick Shells of Revolution", (with G. J. Hutchins), Journal of Applied Mechanics (December 1973) pp. 955-961.

23. "Project Cyclops - A Design Study of a System for Detecting Extraterrestrial Life", contributing author, NASA Report CR114445 (October 1972).

24. "Vibration of Cable Gridworks with Small Initial Deformation", (with H. Afshari), Journal of Applied Mechanics (December 1973), and presented at Winter ASME Meeting, Detroit, Michigan (November 1973).

25. "Transverse Elastic Buckling of Plane Pipe Gridworks", (with H. Afshari, Journal of Structures, ASCE (April 1974).

26. "On Seal Forces in Removable End Closure in Very High Pressure Test Chambers", ASME Journal of Pressure Vessel Technology (February 1975).

27. "Limit Design of Condenser Hotwell Floors", ASME Journal of Engineering for Power (October 1975) pp. 628-633.

28. "Stability of Rotor-Bearing Systems with Generalized Support Flexibility and Damping and Aerodynamic Cross-Coupling", (with R. E. Warner), presented at ASME Lubrication Conference, Toronto (October 1974), and published in the ASME Journal of Lubrication Technology (July 1975) pp. 461-472.

29. "Tubesheet Design in U-Tube Heat Exchangers Including the Effect of Tube Rotational Restraint", published in Journal of Engineering for Industry 98, 4 (November 1976) pp. 1157-1160 and presented at Design Engineering Conference, Chicago, IL (April 1976).

30. "Effective Bending Properties for Stress Analysis of Rectangular Tubesheets", (with W. Hill), published in ASME Journal for Power 99, 3 (July 1977) pp. 365-370, presented at 1976 ASME Annual Meeting.

31. "Stress Analysis of a U-Tube Heat Exchanger Tubesheet with an Integral Channel and an Unperforated Rim", presented by Pressure Vessel and Piping Division, ASME Mexico City Conference (September 1976) (76-PV-58).

32. "Analysis of Beam Columns on Elastic Plastic Foundations with Application to Power Plant Condenser Support Plate Design", (with C. Shahravan), published in ASME Journal of Engineering for Power, 100 (January 1978) pp. 182-188.

33. "Analysis of Closely Spaced Double Tubesheets under Mechanical and Thermal Loading", presented at 1977 Joint Power Generation Conference, ASME, Los Angles, California (77-JPGC-NE-21).

34. "The Tubesheet Analysis Method in the New HEI Condenser Standards", (with M.D. Bernstein), presented at the 1977 Joint Power Generation Conference, ASME, Los Angeles, California, published in ASME Journal for Power 100 (April 1978) pp. 363-368.

35. "Design Curves for Stress Analysis of U-Tube Heat Exchanger Tubesheet with Integral Channel and Head", (with J. E. Soehrens) Journal of Pressure Vessel Technology 100 (May 1978) pp. 221-233.

36. "Design of Condenser Hotwell Floor for Pressure Loading", presented at ASME 1978 Annual Meeting, ASME Advances in Reliability and Stress Analysis H00119 (1979) pp. 203-215.

37. "A Preliminary Assessment of the HEI Tubesheet Design Method - Comparison with a Finite Element Solution", presented at ASME 1978 Winter Annual Meeting, ASME Advances in Reliability and Stress Analysis H00119 (1979) pp. 127-146.

38. "Analysis of Bolted Joints with Nonlinear Gasket Behavior", ASME Journal of Pressure Vessels 102 (August 1980) pp. 249-256.

39. "Stress Analysis of Rectangular Tubesheets for Condensers", Paper 80-C2/NE-14 presented at ASME Nuclear Engineering Conference, San Francisco, California (August 1980).

40. "A Finite Element Model for Thick Beams", (with D. Barrett) Computer Methods in Applied Mechanics and Engineering 25 (1981) pp. 299-313.

41. "A Design Concept for Minimizing Tubesheet Stress and Tubejoint Load in Fixed Heat Exchangers", (with K. P. Singh) 1982 ASME Pressure Vessel and Piping Conference, Orlando, Florida; Int. Journal for Pressure Vessel Technology, Trans. ASME (c. 1982).

42. "Dynamic Coupling in a Closely Spaced Two Body System Vibrating in a Liquid Medium: The Case of Fuel Racks", (with K. P. Singh) 1982 SMIRT Conference, Keswick, England (May 1982).

43. "A Finite Element Model for Thickwalled Axisymmetric Shell", (with D. J. Barrett), ASME Journal of Pressure Vessel Technology 104, (August 1982) pp. 215-222.

44. "Design Parameters Affecting Bolt Load in Ring Type Gasketed Joints", (with K. P. Singh), Journal of Pressure Vessel Technology, Trans. ASME (1984).

45. "Effect of Non-Uniform Inlet Air Flow on Air-Cooled Heat Exchanger Performance", (with K. P. Singh and T. L. Ng) presented at Joint ASME-JSME Transfer Conference, Hawaii (March 1983) and published in Conference Proceedings.

46. "A Method for Computing Maximum Water Temperature in a Fuel Pool Containing Spent Nuclear Fuel", (with K. P. Singh) presented at Fourth International Conference on Pressure Vessels and Piping, Portland, Oregon (June 1983), Nuclear Technology, ANS (c. 1984).

47. "Seismic Response of Free Standing Fuel Rack Constructions to 3-D Floor Motions", (with K. P. Singh) presented at the Fourth International Conference on Pressure Vessels and Piping, Portland, Oregon (June 1983) and published in Nuclear Engineering and Design 80, (1984) pp. 315-329.

48. "Analysis of Tube-Tubesheet Joint loading Including Thermal Loading", (with Xu Hong) published in Journal of Applied Mechanics (June 1984), and presented at 1984 Pressure Vessels and Piping Conference.

49. "Analysis and Design of Pressure Vessel Bolted Flanges with Non Linear Gasket Materials", 11th Conference on Production Research and Technology - Computer Based Factory Automation, Conference Proceedings, Carnegie Mellon University, Pittsburgh, PA (May 1984).

50. "Foundation Stresses under Support of Freestanding Equipment Subjected to External Loads", (with K. P. Singh and I. Gottesman), International Journal of Pressure Vessels and Piping, Vol. 20, No. 2 (1985) pp. 127-138.

51. "Finite Elements for Thick 3-D Shells", (with A. Khaskia), International Journal of Pressure Vessel Technology, 1985.

52. "Tube-to-Tubesheet Rolled Joints: Part I - Analysis Including Strain Hardening and Temperature Dependent Properties", (with S. Weinstock), Proceedings of ASME 1985 Pressure Vessel and Piping Conference H00329, New Orleans, LA.

53. "Tube-to-Tubesheets Rolled Joints: Part II - Experimental Analysis", (with K. Reinis), Proceedings of ASME 1985 Pressure Vessel and Piping Conference H00329, New Orleans, LA.

54. "An Elastic Plastic Analysis of the Integral Tubesheet in U-Tube Heat Exchangers - Towards an ASME Code Oriented Approach", (with K. P. Singh), Proceedings of ASME 1985 Pressure Vessel and Piping Conference H00329, New Orleans, LA.

55. "A Design Procedure for Evaluating the Tube Axial Load due to Thermal Effects in Multi-Pass Fixed Tubesheet Exchangers", (with K. P. Singh), ASME Journal of Pressure Vessel Technology (c. 1986).

56. "Tubesheet Analysis - A Proposed ASME Design Procedure" (with S. Caldwell and K. P. Singh), ASME Karl Gardner Memorial Symposium Proceedings (c. 1986). Channel and an Unperforated Rim, presented by Pressure Vessel and Piping Division, ASME.

57. "Some Results From Simultaneous Seismic Simulations of all Racks in a Fuel Pool", with K.P. Singh, INMM Spent Fuel Management Seminar X, Washington, D.C., January, 1993.

58. Application of Transient Analysis Methodology to Quantify Thermal Performance of Heat Exchangers, I. Rampall, K.P. Singh, A. Soler, and B. Scott, Heat Transfer Engineering, 1997.

59. "Seismic Response Characteristics of HI-STAR 100 Cask System on Storage Pads", with K.P. Singh and Mark G. Smith, INMM Conference, Washington, DC, January, 1998.