November 9, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-445 and
TEXAS UTILITIES ELECTRIC	)	50-446
COMPANY, ET AL.	)	
	)	(Application for
(Comanche Peak Steam Electric	)	Operating Licenses)
Station, Units 1 and 2)	)	

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APPLICANTS' REPORT REGARDING ACADEMIC EXPERT

I. INTRODUCTION

On October 26, 1984, the Atomic Safety and Licensing Board ("Board") in the captioned proceeding, issued a Memorandum (Intent to Retain Academic Expert) ("Memorandum") in which it requested a report on what Applicants had done to retain an expert from the academic community to review Applicants' Plan. Texas Utilities Electric Company, et al. ("Applicants") hereby submit their report.

II. BACKGROUND

On December 28, 1983, the Board issued its Memorandum and Order (Quality Assurance for Design) in which it requested that Applicants produce additional evidence regarding the pipe support design program at Comanche Peak. In response to that Memorandum

and Order, Applicants submitted their "Plan to Respond to Memorandum and Order (Quality Assurance for Design)", on February 3, 1984. Therein Applicants noted their intent

> to retain the services of an expert from the academic community who will be asked to review the basic engineering principles to be addressed in the plan and to provide testimony to the Board. [Applicants' Plan at 4.]

The Board and parties have since agreed to seek resolution of the technical matters addressed in Applicants' Plan through summary disposition, reserving for hearing only those issues on which the Board cannot reach a reasoned decision through the written filings (Memorandum and Order (Written-Filing Decisions, #1: Some AWS/ASME Issues), June 29, 1984 at 2-3). At this time no issues have been identified for which it appears resolution cannot be accomplished on the written pleadings.

In its October 26, 1984, Memorandum the Board inquires as to the status of Applicants' retention of the academic expert mentioned in our Plan.[1] As explained below, in accordance with Applicants' Plan and contrary to CASE's assertion, Applicants

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1 This same topic is the subject of CASE's Second Motion for Summary Disposition Regarding Applicants' Plan and Supplement to Applicants' Plan to Respond to Memorandum and Order (Quality Assurance for Design), filed October 22, 1984. Applicants agree with the Board (Memorandum at 1, n.1) that summary disposition is not the appropriate method for addressing this question. Applicants demonstrate herein that they have satisfied the commitment in their Plan regarding retention of an academic expert. Accordingly, we consider this filing to constitute Applicants' response to CASE's motion and urge that it be denied.

have retained an expert, who has reviewed the basic engineering principles of Applicants' submittals and can present testimony if called upon to do so.

II. APPLICANTS' REPORT TO BOARD

Pursuant to the commitment in their Plan, Applicants retained last April, Dr. Arthur P. Boresi, Head of the Department of Civil Engineering, University of Wyoming, to review the basic engineering principles employed in the review and analyses set forth in Applicants' motions for summary disposition. Dr. Boresi is a well-recognized expert in theoretical and applied mechanics, with extensive qualifications and experience in material and structural behavior. A copy of Dr. Boresi's resume is attached.

Dr. Boresi personally reviewed Applicants' motions for summary disposition. His review and independent analyses did not reveal any defects in Applicants' fundamental engineering approach. Applicants did not, therefore, believe it necessary to amend or supplement any of their motions as a result of Dr. Boresi's review. Applicants have employed some alternative methods of analysis suggested by Dr. Boresi in their responses to NRC Staff questions to further substantiate the adequacy of the designs.

Pursuant to Applicants' commitment in their Plan, Applicants may call Dr. Boresi, as needed, to provide testimony to the Board.[2] Given the present status of these issues, however, we do not believe that such testimony will be required. The Board has yet to receive all filings to be submitted regarding the individual topics addressed under Applicants' Plan. Thus, the Board has not yet determined whether it requires any additional testimony to reach a reasoned decision. Should the Board make such a determination, it may be appropriate for Applicants to call Dr. Boresi to testify on those topics.

Respectfully submitted,

Nicholas S. Reynolds
William A. Horin

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November 9, 1984

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2 Dr. Boresi has served as an expert witness in various legal proceedings, although he has not previously been an expert witness in proceedings before the NRC. To familiarize himself with these proceedings, Dr. Boresi observed portions of the April, 1984, hearings regarding Cygna.

Spring, 1984

Résumé

Name:	Arthur P. Boresi
Citizenship:	U. S. A. Citizen
Family Members:	Wife, Clara Jean (Gordon); three children, Jennifer Ann (Hill), Annette (Pueschel) and Nancy Jean (Lund).
Communication Address:	Department Head, Civil Engineering College of Engineering University of Wyoming University Station Box 3295 Laramie, WY 82071 Phone: (307) 766-5255
Home Address:	3310 Willett Drive Laramie, WY 82070 Phone: (307) 742-5266
Hobbies:	Handball, Fishing, Skiing, Photography

II. Education, Professional Awards, Affiliations, Recognitions

A. Education Background:

Kenyon College, Gambier, Ohio
Premeteorology, 1943-1944

University of Illinois, BSEE, 1948
M.S. (T.A.M.), 1949
Ph.D. (T.A.M.), 1953

Purdue University
Nuclear Engineering - Summer, 1958

University of Michigan
Nuclear Engineering Institute - Summers, 1959, 1961

Argonne National Laboratory
Nuclear Engineering Institute - Summer, 1960

B. Positions Held:

Research Engineer, North American Aviation, Downey, California, 1950

Research Engineer, National Bureau of Standards, Washington, D.C., 1951

Research and Teaching Assistant, University of Illinois 1949 - 1953

Assistant Professor, University of Illinois, 1953 - 1957

Associate Professor, University of Illinois, 1957 - 1959

Professor, University of Illinois, 1959 - 1979

C. Present Rank and Position:

Head and Professor, Department of Civil Engineering, University of Wyoming, 1980 - Present

D. Major Area of Study (Last Degree):

Theoretical and Applied Mechanics

E. Prizes and Honors Awarded:

Nelson E. Rockefeller, New York Science and Technology Award, 1968 - 1969

Naval Sea Systems Research Chair Award, Naval Post Graduate School, Monterey, CA, 1978 - 1979

F. Listed in:

Who's Who in America

American Men and Women of Science

International Scholars Directory

Community Leaders of America

Who's Who in Engineering

Who's Who in the West

Who's Who in the World, 1982

G. Honor Societies:

Phi Eta Sigma (Freshman Honorary)

Eta Kappa Nu (Electrical Engineering Honorary)

Sigma Tau (All Engineering Honorary)

Tau Beta Pi (Engineering Honorary)

Sigma Xi (Research Society)

Pi Mu Epsilon (Mathematics Honorary)

H. Professional Affiliations: Professional Engineers License, Technical and Educational Societies:

Engineering Science Society, Member, 1980

American Society of Mechanical Engineers (ASME) Fellow, 1965

American Academy of Mechanics, 1972

H. Professional Affiliations (Cont'd.):

American Society of Civil Engineering (ASCE) Fellow, 1970

American Society for Engineering Education (ASEE), 1959

Society for Experimental Stress Analysis (SESA), 1962

I. Special Grants and Awards:

Nelson E. Rockefeller, New York Science and Technology Award, 1968 - 1969, $25,000.00

Naval Sea Systems Research Chair Award, Naval Post Graduate School, Monterey, CA, 1978 - 1979, $48,000.00

J. Invited Lectures:

Large Natural Draft Cooling Towers, Strength and Stability Mechanical Engineering Department, Syracuse University, Syracuse, New York, December 19, 1968

Stability of Axisymmetric Shells of Revolution Subjected to Wind Load, Civil Engineering Department, Imperial College of Science and Technology, London, January 21, 1969

Calculation of Buckling of Reentrant Shell Subjected to Uniform External Pressure, ASCE National Meeting on Structural Engineering, Louisville, Kentucky, April 14-18, 1969

Computations in Continuum Mechanics, Clarkson College of Technology, Potsdam, New York, January 29, 1970

Calculation of the Response of Rods to Boundary Layer Pressure Fluctuations, Conference on Flow Induced Vibrations in Reaction System Components, Argonne National Laboratory, May 14, 1970

Fluid Solid Interaction Problems, Clarkson College of Technology, Potsdam, New York, May 6, 1971

Shakes and Shudders of an Ecological Structure (The Large Natural Draft Cooling Tower), Rochester Institute of Technology, Rochester, New York, April 7, 1971

Creep of Metals Under Multiaxial States of Stress, First International Conference on Structural Mechanics in Reactor Technology, West Berlin, September 21, 1971

J. Invited Lectures (Cont'd.):

Creep of Meta's, McGill University, Montreal, Quebec, December 15, 1971

High Temperature Problems in Metals, Ninth Annual International Symposium of Applied Mechanics, Sponsored by Institute Tecnologico y de Estudios Superiores de Monterrey, April 2-3, 1972, Nouvo Leon, Mexico

Strength of Large Cooling Towers Subject to Wind Loads, Oklahoma State University, Stillwater, Oklahoma, February 24, 1972

On the Gun-Pointing Accuracy Study of an Anti-Armor Automatic Cannon, General T. J. Rodman Laboratory, Rock Island Arsenal, Rock Island, Illinois, January 27, 1977

Excitation of a Gun Barrel due to Firing, U.S. Army Armament Research and Development Command, Rensselaerville, New York, September 20, 1978

Accuracy of Small Dispersion Anti Armor Cannon, Weapons Engineering Naval Post Graduate School, April 20, 1979

Design of Large Natural Draft Cooling Towers, Mechanical Engineering Naval Post Graduate School, January 18, 1979

The Large Natural Draft Cooling Tower: Stress Analysis and Stability, Civil Engineering Department, University of California at Davis, May 24, 1979

Structural Dynamics (A General Topic with Specific Applications), Civil and Architectural Engineering Department, University of Wyoming, October 13,1980

Gun Pointing Accuracy, Civil and Architectural Engineering Department, University of Wyoming, Laramie, February 13, 1981

The Dynamics of Elastic Gun Tubes, Engineering Science Department, University of Florida, Gainesville, November 14, 1981

Gun Dynamics, Mecnanical Engineering Department, University of Wyoming, Laramie, March 25, 1982

State-of-the-Art of Dynamics of Flexible Gun Tubes, Launch and Flight Division, Ballistic Research Laboratory, Aberdeen, MD, Jan. 26, 1984.

K. Short Courses Offered:

Finite Elements for U.S. Industrial and Chemical Corporation, Tuscola, Illinois, June 15-20, 1975

III. Professional Activities:

A. Non-Academic:

1. Consulting:

Consultant, Atomic Energy Commission, 1958 - 1961

Consultant, Kirtland Air Force Base, Albuquerque, New Mexico, 1957 - 1962

Consultant, Allison Division, GMC, Indianapolis, Indiana, 1960 - 1969

Consultant, The Marley Company, Mission, Kansas, 1965 -1979

Consultant, U.S. Industrial Chemical Corporation, Tuscola, Illinois, 1973 - 1979

Consultant, U.S. Army, Rodman Laboratory, Rock Island Arsenal, Rock Island, Illinois, 1974 - 1979

Consultant, Chicago Bridge and Iron Company, Chicago, Illinois, 1968 - 1970

Consultant, Fenix and Sisson, Inc., Tulsa, Oklahoma, 1959 - 1962

Consultant, Woodward, Clyde and Sherrad, Oakland, California, 1960 - 1963

Consultant, B. C. Christopher & Co. (Cape Grain Company), Cape Girardeau, Missouri, 1973 - 1974

Consultant, Libbey-Owens-Ford, Toledo, Ohio, 1979 - present

Consultant, U.S. Army Corps of Engineering, 1979 - present

Expert Witness for several law firms

Head, Consulting Firm of BLM Applied Mechanics Consultants, 1960 - present

2. Professional Engineer Activities:

He served on the University of Illinois Professional Engineers Education Committee from 1969 - 1979. During this time, he taught refresher courses for the Illinois

2. Professional Engineer Activities (Cont'd.):

Professional Engineering Examination to over 3000 engineers on electrical, mechanical, and civil engineering topics. He contributed heavily to the writing of the text, Professional Engineer Notes, University of Illinos, Office of Continuing Education and Public Service, Champaign, Illinois, which served to prepare engineers for licensing in Illinois, and he contributed to the Typical Questions Manual used by engineers to prepare for the Illinois Professional Engineers Examination.

3. Industrial Experience:

Argonne National Laboratory, Argonne, Illinois, Mechanics Division, 1961

U.S. Army Construction Engineering Laboratory, Champagne, Illinois, 1977

Research Engineering, North American Aviation, Downey, California, 1950

Materials Engineering, National Bureau of Standards, Washington, D.C., 1951

4. Government Experience:

Delegate to Geneva Disarmament Conference, 1958-1959

5. Professional Boards, Position Held:

Vice Chairman Stability Committee, ASCE Engineering Mechanics Division, 1979-1980

Chairman, Stability Committee, ASCE Engineering Mechanics Division, 1980 - 1982

Vice Chairman, Stability Committee, ASCE Engineering Mechanics Division, 1982-1983

Treasurer, American Academy of Mechanics, 1974-1977

5. Professional Boards, Position Held (Cont'd.):

Vice Chairman, Publication Committee, ASCE Engineering Mechanics Division, 1981-1984

Committee Member, Programs Committee, ASCE Engineering Mechanics Division, 1980-1982

Member, Composite Materials Committee, Society of Experimental Stress Analysis, 1983

Member, Fracture Committee, Society of Experimental Stress Analysis, 1983

Member, Structural Testing Committee, Society of Experimental Stress Analysis, 1983

Member-at-Large, Structural Stability Research Council 1983-1985

6. Technical Meeting Activities:

Chairman, ASME Applied Mechanics Division, Shells Session, 1968

Chairman, ASME/ASCE Joint Conference, Boulder, CO, Stability Session, June 1981

Co-Chairman, Applied Mechanics Session, Chicago, IL, 1964

Chairman, Stability Session, ASCE Spring Meeting, Las Vegas, Nevada, April 26-30, 1982

Co-Chairman, Experimental Mechanics Methods (Moire I), Spring Meeting Society of Experimental Stress Analysis, Hawaii, May 1982

Chairman, Session No. 52, Dynamic Stability of Engineering Systems, ASCE, 1982 Annual Convention, New Orleans, LA, October 25-27, 1982

Chairman, Session No. ST-1, Stability of Shells, Fourth ASCE-EMD Specialty Conference, Purdue University, West Lafayette, IN, May 23-25, 1983

7. Paper Review Activities:

AIAA (American Institute for Astronautics and Aeronautics)

Journal of Applied Mechanics, ASME

Journal of Engineering Mechanics, ASCE

Journal of Structural Engineering, ASCE

Nuclear Engineering and Design Journal

Applied Mechanics Reviews

8. Editorial Activities:

Editorial Committee of the Tenth Southeast Conference of Theoretical and Applied Mechanics

Engineering Mechanics Editor, Nuclear Engineering Design Journal, 1965 - Present

Associate Editor, International Journal of Structural Mechanics, 1982 - Present

Editorial and Planning Committee, Purdue ASCE:EMD Specialty Conference, May 1983

B. Academic Activities - Non-Teaching, Curriculum, Thesis Advising, etc.:

1. Undergraduate Student Advising (average number per semester)

University of Illinois, 5 per semester

University of Wyoming, 15 per semester

2. M.S. Student Advising:

University of Illinois, Approximately 40 students during the period of 1956 -1979

University of Wyoming, Laramie

Name	Date
Charles Ofodum	1981
James Fillerup	1982

3. Ph.D. Student Thesis Advising

University of 1Illinos, 21 students during the period of 1960 - 1979

Name	Date
John E. Bower	1961
Paul E. Wilson	1961
Emory L. Kemp	1962
Robert J. Nikolai	1962
James L. Hill	1963
George Sliter	1963
Ralph M. Verette	1963
Robert M. Jones	1964
Charles C. Fretwell	1965
I. C. Wang	1966
Robert D. Cook	1967
Frank Vigneron	1968
R. M. Kanazawa	1969
Thomas W. Pickel, Jr.	1969
J. E. Stoneking	1970
T. R. Branca	1971
J. L. Ford	1973
Gordon H. Holze	1974
Y. K. Liao	1977
S. K. Sharma	1977
S. Jerath	1978
University of Wyoming: Laramie	
K. A. Wang	1980

4. Course-Curriculum Development or Other Innovations:

Nuclear Engineering Curriculum, University of Illinois, 1960 - 1968

Theoretical and Applied Mechanics Curriculum, Undergraduate, 1960 - 1965

Theoretical and Applied Mechanics Curriculum, Graduate, 1965 - 1970

Engineering Science, Graduate Program, Clarkson College, Potsdam, New York, 1968 - 1969

5. Other Student Activities

Engineering Mechanics Faculty Advisor, University of Illinois, 1970 - 1971

Nuclear Engineering Faculty Advisor, University of Illinois, 1965 - 1979

C. Academic Activities (Direct Teaching of Classes)

1. Undergraduate Courses

University of Illinois: Champaign-Urbana (1949 - 1979)

Engineering Mechanics I (Statics & Dynamics)

Advanced Dynamics I

Vibrations I

Strength of Materials

Introduction to Nuclear Engineering

Continuum Mechanics

Matrix Methods in Engineering

University of Wyoming: Laramie

Semester-Year	Number	Subject
Fall, 1980	EnSci 404D-1	Mechanics of Materials

2. Graduate Courses

University of Illinois: Champaign-Urbana (1953 - 1979)

Advanced Dynamics II

Vibrations II

Advanced Strength of Materials

Elasticity I and II

Energy Methods in Mechanics

Theory of Shells

Thermomechanics Problems in Nuclear Reactors

Theory of Stability (Structural Buckling)

University of Wyoming: Laramie

Semester-Year	Number	Subject
Spring, 1980	CE 790M-1	Advanced Mechanics of Materials
Spring, 1980	CE 804D	Theory of Plates and Shells
Spring, 1981	CE 700K	Theory of Elasticity
Spring, 1981	CE 790M-3	Structural Dynamics
Fall, 1981	CE 790M-3	Structural Mechanics
Spring, 1982	CE(ME) 700K	Theory of Elasticity

D. Visiting Professorships, Visiting Fellows, Other Visiting Positions Held

Distinguished Visiting Professor, Clarkson College of Technology, Potsdam, New York, 1968 - 1969

Distinguished Visiting Professor, Naval Post Graduate School, Monterey, California, 1978 - 1979

E. Other Service to the University

1. Department Activities - Committees

University of Illinos: Champaign-Urbana

Solid Mechanics Coordinator for Department of Theoretical and Applied Mechanics (TAM) (3 years)

Member Executive Committee for TAM (5 years)

Seminar Coordinator for Graduate Program (4 years)

Curriculum Committee, Nuclear Engineering Program (10 years)

Committee on Heat Transfer, Fluids, and Continuum Mechanics in Nuclear Engineering (Chairman) (2 years)

Curriculum Committee (TAM) (4 years)

University of Wyoming: Laramie

Civil and Architectural Engineering Head Search Committee 1980

2. College Activities - Committees

University of Illinois: Champaign-Urbana

Member Nuclear Engineering Advisory Group (15 years)

Department Representative of College Policy and Development Committee (Served as Secretary and Chairman) (3 years)

University of Wyoming: Laramie

Engineering Building Committee, 1980 - Present

ASEE Activities Committee, 1980 - Present

Dean's Head Committee, 1981 - Present

Faculty Student Committee, 1981 - Present

3. University Activities - Committees

University of Illinois - Champaign-Urbana

Member Liaison Committee, University of Illinois and U.S. Army Construction Engineering Research Laboratory (8 years) 1971 - 1979

University of Wyoming - Laramie

Chairman, WRRI Review Committee, 1981

Presidential Search and Screening Committee, 1981 - 1982

Review Committee for Chemical Engineering, 1981 - 1982

Personnel Task Force - L.E.T.C./Wyoming Research Corp., 1983

F. Research Proposals Awarded

Name	Agency	$ Amount	Date
Stability of Shells	Office of Naval Research	$240,000.	1954-1960
Engineering Science Graduate Program	New York Science Foundation	$ 25,000.	1968-1969
Dynamic Response of Viscoelastic Solid	U.S. Army Construction Research Laboratory	30,000.	1971-1972
Gun Dynamics Stress Analysis	Rock Island Arsenal	49,000.	1973-1975
Gun Pointing Accuracy	U.S. Army Ballistics Research Lab.	96,980.	1978-1979
Coal Evaluation in Rock Springs and Kemmerer Areas, WY	U.S.G.S.	406,412.	1981-1983
Volcanic Rock Region Oil Exploration Consortium	17 Companies	35,000./company/annually	1981--

IV. Publications (Full Reference Information)

A. Books (Title, Publisher, Date)

1. Published

Elasticity in Engineering Mechanics, Prentice-Hall International, New York, NY, 1965, Second Edition, 1974

Engineering Mechanics, Vol. I - Statics, Vol. II - Dynamics McGraw-Hill, 1959 (with H. L. Langhaar)

1. Published (Cont'd.)

Advanced Mechanics of Materials, J. Wiley & Sons, New York, 3rd Ed., 1978, 696 pages (Selected as Mechanical Engineers Book of the Month, McGraw-Hill Book Company, November, 1979)

Editor of and Contributor to Problems in Applied Mechanics, The Proceedings of a Symposium Honoring Professor H. L. Langhaar, University of Illinois, Urbana, April, 1978

2. In Progress

Currently working on the 4th Edition of Advanced Mechanics of Materials, 3rd Edition, John Wiley and Sons, New York, 1978

Currently working on the 3rd Edition of Elasticity in Engineering Mechanics, 2nd Edition, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1974

Currently working on 2nd Edition of Engineering Mechanics, 1st Edition, McGraw-Hill Book Company, New York, NY

3. Book Reviews

"Design for Creep," by R. K. Penny and D. L. Marriott, McGraw-Hill Book Company (UK) Ltd., 1971, 291 pages, 167 figures in Nuclear Engineering and Design 22 (1972) 366-368

"Dynamic Problems of Thermoelasticity," by W. Nowacki, edited by P. H. Francis and R. B. Hetnarski, Leyden, The Netherlands, Noordhoff International (Warsaw, Poland, PWN-Polish Scientific) (1975), xv + 436 pp. in Applied Mechanics Reviews, Vol. 29, No. 10, October 1976, p. 1529

"Current Work on Behavior of Material at Elevated Temperature," edited by A. O. Schaefer, The American Society of Mechanical Engineers, United Engineering Center, New York, New York, (1974), 185 pages in Applied Mechanics Reviews, Vol. 29, No. 9, pp. 1381-1382

"Wind and Seismic Effects," Lew, H. S., editor, Proceedings of the Seventh Joint Panel Conference of the U.S. - Japan Cooperative Program in Natural Resources, May 20-23, 1975, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C., (1977) xvii + 495 pp., in Applied Mechanics Reviews, Vol. 30, No. 4, pp. 479-480

B. Papers Submitted to and Accepted for Publication or Already Published in High Level Technical Journals or Proceedings with Rigorous Review Procedures

"Coefficients of irregularity of a rotating system considering torsional elasticities of the shaft," Proceedings of the First U.S. National Congress of Applied Mechanics, June, 1951, pp. 111-118

"A refinement of the theory of buckling of rings under uniform pressure," Journal of Applied Mechanics, Vol. 22, No. 1, March 1955, pp. 95-102

"Buckling and post-buckling behavior of cylindrical shells subjected to external pressure," Book of Abstracts, Section II, IX International Congress of Applied Mechanics, Brussels, 1956, p. 26 (with H. L. Langhaar)

"Strain energy and equilibrium of a shell subjected to arbitrary temperature distribution," Proceedings of the Third U.S. National Congress of Applied Mechanics, June 1958, pp. 393-400 (with H. L. Langhaar)

"Snap-through and post-buckling behavior of cylindrical shells under the action of external pressure," Engineering Experiment Station Bulletin No. 443, University of Illinois, Urbana, April 1957 (with H. L. Langhaar)

"Buckling of a cylindrical shell subjected to external pressure," Osterreichisches Ingenieur - Archive, XIV (3), 1960, pp. 189-203 (with H. L. Langhaar)

"Critical study of the Prot Method of fatigue testing," Revue Generale de Mechanique, 38 (62), February 1954, pp. 5-60 (with T. J. Dolan)

"Energy theory of buckling of circular rings and arches," Proceedings of the Second U.S. National Congress of Applied Mechanics, June 1954, pp. 437-444 (with H. L. Langhaar)

"String energy expression for a circular cylinder shell including transverse shear efects," Developments in Mechanics, Vol. 1, Plenum Press, 1961, pp. 340-354 (with R. E. Miller)

"Effect of certain approximations upon the theoretical buckling of circular rings and arches," Developments in Mechanics, Vol. 1, Plenum Press, 1961, pp. 128-142 (with C. S. Chen)

B. Papers Submitted to and Accepted for Publication or Already Published in High Level Technical Journals or Proceedings with Rigorous Review Procedures (Cont'd.)

"Deflections of non-homogeneous anisotropic elastic-plates subjected to heating," Proceedings of Indian Theoretical and Applied Mechanics symposium, 1961, pp. 21-31 (with H. L. Langhaar and R. E. Miller)

"Equilibrium and stability of a ring under non-uniformly distributed pressure," Proceedings of Fourth U.S. National Congress on Applied Mechanics, Berkeley, CA, June 18 -20, 1962, pp. 459-467

"Buckling of axially-compressed bilayered fiber-reinforced elastic cylindrical shell," Proceedings, Second Southeastern Conference on Theoretical and Applied Mechanics, 1964, pp. 95-116

"Elastica supported at midpoint by a spring," Engineering Mechanics Journal, ASCE, April 1964, pp. 1-15

"Large deflection of a clamped circular plate including effects of transverse shear," Journal of Applied Mechanics, Vol. 31, Series E, No. 3, 1964. pp. 540-541

"Buckling of axially compressed cylindrical shells reinforced by circumferential fiber winders," AIAA Journal, Vol. 3, No. 1, 1965, pp. 175-177 (with H. L. Langhaar, G. Love, and L. Marcus)

"Buckling of a long fiber-wound cylindrical shell due to stresses caused by windings,"Journal of Applied Mechanics, Vol. 32E, No. 1, 1965, pp. 81-86 (with H. L. Langhaar, L. Marcus, and G. Love)

"Stress problem of contiguous coaxial circular cylinders subjected to non-homogeneous temperature distribution and to pressure," Journal of Nuclear Structural Engineering, Vol. 1, No. 2, 1965, pp. 86-97

"Elastic plates: Annotated bibliography 1930-1962, University of Illinois, Enginering Experiment Station, Technical Report No. 10, October 1964 (with G. E. Sliter and R. J. Nikolai)

"Relations among stresses, stress resultants, and moments for the axi-symmetric elastic shell problem," Journal of Applied Mechanics, Vol. 33, Series E, No. 2, 1966, pp. 455-456

"Buckling of a uniformly compresed ring with radial elastic support," Proceedings of the Ninth Midwestern Mechanics Conference, Vol. 3 Developments in Mechanics, John Wiley & Sons, 1967, pp. 443-449 (with G. E. Sliter)

B. Papers Submitted to and Accepted for Publication or Already Published in High Level Technical Journals or Proceedings with Rigorous Review Procedures (Cont'd.)

"Energy Methods in parametric excitation of rings," Nuclear Engineering and Design, Vol. 2, 1968, pp. 196-202 (with H. C. Reichenbach)

"Creep closure of a spherical cavity in an infinite medium (with special application to Project dribble, Tatum Salt Dome, Mississippi)," AECU-8163, United States Atomic Energy Commission, 1968

"Strain energy expression for large deformations of isotropic elastic shells subjected to arbitrary temperature distribution," Nuclear Engineering and Design, Vol. 5, No. 4, 1966, p. 443-464 (with I. C. Wang)

"Buckling of a cooling tower," Proceedings of Canadian Congress of Applied Mechanics, Laval University, Vol. 1, 1967, pp. 1-130 (with H. L. Langhaar and R. E. Miller)

"Analyses of circular bars and tapered twisted bar," Proceedings of the 10th Midwestern Mechanics Conference, 1968, pp. 601-614 (with R. E. Miller)

"On a theory for axisymmetric elastic shells of moderate thickness," Proceedings 4th Southeastern Conference on Theoretical and Applied Mechanics, 1969, pp. 199-220 (with R. J. Nikolai)

"Convergence criteria and error estimations for finite element stiffness methods in plate bending," Proceedings Canadian Congress of Applied Mechanics, Vol. 2, University of Waterloo, 1969, pp. 287-288

"Kinds of convergence and improved convergence of conforming finite element solutions in plate bending," Nuclear Engineering and Design, Vol. 11, No. 9, March 1970, pp. 159-176

"Stability of hyperboloidal cooling tower," Proceedings of ASCE, Vol. 96, No. EM5, October 1970, pp. 753-779 (with R.E. Miller and H. L. Langhaar)

"Calculations of the response of rods to boundary layer pressure fluctuations," Proceedings of the Conference on Flow-Induced Vibrations in Reactor System Components, ANL-7685, (with R. M. Kanazara)

"A theory of free vibration of orthotropic shells of revolution," Nuclear Engineering and Design, Vol. 14, Part 2, 1970, pp. 271-285 (with T. E. Stoneking)

B. Papers Submitted to and Accepted for Publication or Already Published in High Level Technical Journals or Proceedings with Rigorous Review Procedures (Cont'd.)

"Effect of the earth's gravitational forces of the flexible crossed-dipole satellite configuration, 1: Configuration stability and despin," Canadian Aeronautics and Space Institute Transaction, Vol. 3, Part 2, 1970, pp. 115-126 (with Frank Vigneron)

"Evaluation of creep laws and flow criteria for two metals subjected to stepped load and temperature changes," Experimental Mechanics, Vol. 11, No. 5, May 1971, pp. 1-8

"Creep of metals under multiaxial states of stress," Nuclear Engineering and Design, Vol. 18, No. 3, February 1972, pp. 416-456 (with O. M. Sidebottom)

"Periodic response of a visco-elastic cooling tower," Nuclear Engineering and Design, Vol. 22, No. 1, August 1972, pp. 75-94 (with H. L. Langhaar)

"Creep of a uniaxial metal matrix composite subjected to axial and normal lateral loads," Proceedings of the First International Conference on Structural Mechanics in Reactor Technology, Vol. 6, Part L. 1973, pp. 109-131 (with T. R. Branca)

"Hydroelastic vibrations of reactor fuel rods subject to parallel turbulent flow," Proceedings of the First International Conference on Structural Mechanics in Reactor Technology, Vol. 3, Part E, 1973, pp. 247-275 (with R. M. Kanazawa)

"Computer Mapped Hologram Immages," Engineering Mechanics Journal, ASCE, April 1974 (with J. L. Ford)

"Periodic excitation of a finite linear viscoelastic solid," Nuclear Engineering and Design, Vol. 30, No. 3, September 1974, pp. 349-368 (with H. L. Langhaar and R. E. Miller)

"Free vibration analysis using substructuring," Journal of the Structural Division, ASCE, December 1975, Proceedings Paper 1178, pp. 2627-2639

"Stress analysis for time-dependent problems in rock mechanics," 2nd Congress of the International Society of Rock Mechanics, Vol. 2, 1976, pp. 4-21, Belgrade

B. Papers Submitted to and Accepted for Publication or Already Published in High Level Technical Journals or Proceedings with Rigorous Review Procedures (Cont'd.)

"On the gun point accuracy of an anti-armor automatic cannon," (with H. L. Langhaar, R. E. Miller, and S. C. Chu), Proceedings 1st Conference on Dynamics of Precision Gun Weapons, U.S. Army Armament Research and Development Command, Dover, NJ, 1977, pp. 577-602

"Boundary conditions at a cone-cylinder shell junction," Journal of Applied Mechanics, Vol. 45, December 1978, pp. 938-941

"Analysis of silos subjected to grain and wind loads," Proceedings of the 8th U.S. Congress of Applied Mechanics, U.C.L.A., Los Angeles, CA, June 26-30, 1978 (with S. Jerath)

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1. Vibrations of a Turbine Wheel with Rigid Blades, November 1964; Supplement: Scale Factors for Normalizing Vibration Analysis of a Turbine Wheel. See also AAMR No. 4

2. Large Axially Symmetric Deflections of Heated Shells of Revolution, November 1964

3. Large Axially Symmetric Deflections of Heated Shells of Revolution, November 1964. Addendum to AAMR No. 3, April 1965

4. Strain Energy of a Circular Ring of Constant Cross Section, December 1964

5. Thermal Stresses in Turbine Blades, January 1965

6. Strain Energy of a Twisted Vane, January 1965

7. Bending Vibration of Cantilever Blades, January 1965

8. Differential equations for Circular Bar Subjected to Axial, Transverse, and Torsional Loads, January 1965. Addendum to AAMR No. 8: Temperature Effects in a Circular Bar, June 1965. See also AAMR No. 5

9. Isothermal Analogy for Thermal Stresses in Turbine Blades, February 1965

10. Differential Equations for a Tapered Twisted Bar, March 1965

11. Energy Method of Analysis of Bending of Bearing Support Structures, March 1965

12. Plane Stress Problem of a Disk Subjected to Radially Directed Point Edge Load by the Method of Fourier Series, May 1965

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16. Plane Stress Problem of a Rimmed Disk Subjected to Radially and Tangentially Directed Concentrated Edge Loads, May 1965

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19. Vibrations of a Turbine Wheel with Flexible Blades, October 1965

20. Elastic Axis and Torsional Stiffness of Simple Turbine Blade with Ramp Angle, December 1965. Addendum: October 1966

21. Free Vibration of a Turbine Wheel: Finite-Difference Method, December 1966

22. Lateral Vibration of a Rectangular Cantilever Flat Plate, March 1967

23. Plane Stress Problem of Turbine Wheel with Variable Thickness and Nonhomogeneous Orthotropic Material, March 1967

24. Bending of Beryllium Plates, March 1967

25. Plane Stress Problem of Turbine Wheel with Variable Thickness and Nonhomogeneous Anisotropic Material, July 1967

26. Approximate Method of Computation of Stresses and Deformation of a Centrifugal Compressor Blade, January 1968

27. Recommendations on the Calculation of Elastic and Creep Deformation of Nonhomogeneous Turbine Disks of Variable Thickness, January 1968

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31. Effects of Creep in Gas Turbine Blades, February 1965

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33. Differential Equation for Circular Bar . . .: Circular Ring with Internal Pressure, May 1965

34. Thermal Stresses in Turbine Blades . . . Flat Plate Example, July 1965

35. Shell to Enforce Node Line in Rotating Disk, August 1965

36. Examples for Check of Numerical Analysis of Thermal Stress Problems of Turbine Blades, September 1965

37. Nonlinear Theory of Rotationally Symmetric Shells, December 1965

38. Thermal Stresses in a Rectangular Flat Plate, January 1966

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40. Comparison of Exact and Approximate Solutions of a Thermal Stress Problem, October 1966

41. Representation of a Tabulated Function of Two Variables by a Double Trigonometric Sum, October 1966

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43. Data Input for Direct Solution Frame Program, January 1968

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2. Analysis of Cylindrical Cooling Tower, October 1965

3. Preliminary Analysis of the Hyperboloidal Cooling Tower, November 1965

4. Buckling of a Cylindrical Shell Subjected to Wind Pressure, December 1965

5. Summary of Calculations on Buckling of a Cylindrical Shell Under Wind Pressure, February 1966

6. Comparison of Membrane Solution and Bending Analysis of Stresses in a Cylindrical Shell, May 1966

7. Membrane Analysis of Stresses in Fort Martin Cooling Tower, August 1966; Addendum to Marley Applied Mechanics Report No. 7: Membrane Analysis of Stresses in Fort Martin Cooling Tower, September 1966. Second Addendum to Marley Applied Mechanics Report No. 7: Displacements in Fort Martin Cooling Tower, August 1966

8. Stability of the Fort Martin Cooling Tower, October 1966. Addendum to Marley Applied Mechanics Report No. 8: Stability of the Fort Martin Cooling Tower: Addendum, March 1967

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12. Summry Report of Structural Analyses of Cooling Towers, January 1969

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14. Summary Report on Membrane Theory of Cooling Towers: Preparation of Computer Program Input Data and Subroutines, October 1969

15. Buckling of a Cooling Tower under Self Weight, November 1969

16. Effect of Weight on the Stability of a Cooling Tower, November 1969

17. Dynamic Overloading of Cooling Towers, January 1970

18. Commentary on Stress Analysis of Cooling Towers, January 1970

19. Stability of Cooling Towers with Tapered Shells, March 1970

20. Membrane Analysis of a Cooling Tower with a Bulge, April 1970

21. Dynamic Overloading of a Cooling Tower, May 1970

22. Free Vibrations of Shells of Revolution, July 1970

23. Forced Vibration of a Cooling Tower, August 1970

24. Critical Review of the Paper "Earthquake Design of Cooling Towers," September 1970

25. Forced Vibration of a Cooling Tower (Extension of MAMR No. 23), October 1970

26. Aeroelastic Modelling of a Cooling Tower, October 1970

27. Damping of Viscoelastic Structures, December 1970

28. Periodic Response of a Viscoelastic Cooling Tower to Gusts or Earthquakes, January 1971

29. Effect of Out-of-Roundness on Stresses in a Cooling Tower, May 1971

30. Finite Difference Equations and Computer Program for Periodic Response of a Viscoelastic Cooling Tower to Gusts or Earthquakes, June 1971

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31. Stress Analysis of a Cooling Tower with Equally-Spaced Stress Concentrations at the Bottom of the Shell, November 1971

32. Propagation of Edge Stress Concentration in a Hyperboloidal Cooling Tower, June 1972

33. Digital Computer Program for Static Stresses in Shells, September 1972

34. Digital Computer Program for Static Stresses in Shells (Extension of MAMR No. 31), November 1972

35. Statistical Analysis of Drop Sizes, December 1973

36. User's Manual for Finite Element Shell Programs SAMMSOR-III (Modified) and STADYN, October 1973

37. Statistical Analysis of Drop Sizes (Extension of MMR No. 35), January 1974

38. The Computer Code STADYN (Extension of MAMR No. 36), April 1974

39. Boundary Conditions for Column Supported Shell of Revolution, April 1974

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41. Statistical Analysis In Cooling Towers with Multilayered Steel Reinforcements - Including the Effects of Temperature Gradients, November 1974

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6. A Computer Program for Coefficients of Thermal Conductivity for an Axisymmetric Solid Made Anisotropic by Holes, July 1974

7. A Computer Program for Elastic and Thermal Constants for an Axisymmetric Solid Made Anisotropic by Holes, July 1974

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9. Computer Programs for Displacements, Strains and Stresses in an axisymmetric Nonhomogeneous Solid, July 1974

10. Computer Programs for Displacements, Strains and Stresses in an Axisymmetric Nonhomogeneous Solid with Multiple Loading Conditions, July 1975

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2. "The Kirchhoff-Clebsch Theory of Thin Elastic Rods," Interim Report BLM-AMC-81-2, Contract No. DAAK11-80-C-0039, BRL, Aberdeen, MD 20 April 1981, 22 pages

3. "Free Rigid Tube with Eccentric Breech Block," Interim Report BLM-AMC-81-3, Contract No. DAAK11-80-C-0039, BRL, Aberdeen, MD, 27 April 1981, 22 pages

4. "Free Rigid Gun with Eccentric Breech and Dynamically Lopsided Projectile," Interim Report BLM-AMC-81-4, Contract No. DAAK11-80-C-0039, BRL, Aberdeen, MD, 27 May 1981, 33 pages

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6. "Dynamics of a Projectile in a Flexible Tube," Interim Report BLM-AMC-81-6, Contract no.DAAK11-80-C-0039, BRL, Aberdeen, MD, 1 August 1981, 24 pages

7. "Forces and Moments Acting on a Free Rigid Gun with an Eccentric Breech," Interim Report BLM-AMC-81-7, BRL, Aberdeen, MD 1 September 1981, 15 pages

8. "Forces and Moments on a Rigid Immovable Gun," Interim Report BLM-AMC-81-8, BRL, Aberdeen MD, 10 September 1981, 12 pages

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9. "Forces and Moments on a Freely-Recoiling Rigid Gun That is Constrained Against Rotation," Interim Report BLM-AMC-81-9, Contract No. DAK11-80-C-0039, BRL, Aberdeen, MD 21 September, 1981

10. "Dynamics of Rigid Guns with Straight Tubes," Final Report DAAK11-80-C-0039-Task 2, BRL, Aberdeen, MD, 1 November 1981, 80 pages

11. "Plane Excitation of an Elastic Gun Barrel," Interim Report BLM-AMC-81-10, Contract No. DAAK11-80-C-00393, BRL, Aberdeen, MD, 28 December 1981, 57 pages

12. "A Review of Selected Works on Gun Dynamics," Final Report DAAK11-80-C-0039, Task 1, BRL, Aberdeen, MD, 1 January 1982, 43 pages

13. "Gyroscopic Action of a Spinning Projectile in a Rigid Curved Tube," Interim Report BLM-AMC-82-1-Task 3, Ballistic Research Laboratory, Aberdeen, MD, 20 January 1982, 17 pages

14. "Kinematics of a Balanced, Rigid, Spinning Projectile in a Flexible Tube," Interim Report BLM-AMC-82-2-Task 3, Ballistic Research Laboratory, Aberdeen, MD, Contract No. DAAK11-80-C-0039, 20 February 1982, 39 pages

15. "Forces and Moments Acting on a Balance Projectile in a Flexible Tube," Interim Report BLM-AMC-82-3-Task 3, Ballistic Research Laboratory, Aberdeen, MD, Contract No. DAAK11-80-C-0039, 1 March 1982, 21 pages

16. "Dynamics of a Balanced Spinning Projectile in a Flexible Tube: Scalar Theory," Interim Report BLM-AMC-82-4-Task 3, Ballistic Research Laboratory, Aberdeen, MD, Contract No. DAAK11-80-C-0039, 20 March 1982

D. Nontechnical Publications of Concern to Engineering Rcle in Society

Several newspaper articles on Engineering, High Temperature Materials, Nuclear Engineering

V. Areas of Research Specialization

A. Applied Mechanics - Solid Mechanics

Elasticity

Energy Methods

Stability Theory

Plates, Shells and Rings

Numerical Methods (Finite Elements; Approximation Techniques)

Advanced Mechanics of Materials

B. Engineering Education

Teaching Techniques

Text Book Writing

C. Expert Witness Specialization

Failure of Structures

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-445 and
TEXAS UTILITIES ELECTRIC	)	50-446
COMPANY, et al.	)	
	)	(Application for
(Comanche Peak Steam Electric	)	Operating Licenses)
Station, Units 1 and 2)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Applicants' Report Regarding Academic Expert", in the above-captioned matter was served upon the following persons by express delivery (*), or deposit in the United States mail, first class, postage prepaid, this 9th day of November, 1984, or by hand delivery (**) on the 12th day of November, 1984.

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