

DR. RONALD E. FRISHMUTH, P.E.

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TECHNICAL AREAS OF EXPERTISE:

Structural Analysis
Fatigue and Fracture Mechanics
Failure Analysis
Mechanical Behavior of Materials

BUSINESS EXPERIENCE OVERVIEW:

Oil Field Equipment Manufacturing
Gas Turbine Industry
Basic Metal Supplier
Consulting and Testing Business

EDUCATION:

Ph. D., Theoretical and Applied Mechanics, University of Illinois, 1974

M. S., Engineering Mechanics, The Pennsylvania State University, 1969

B. S., Civil Engineering, Drexel University, 1967

LICENSES:

Professional Engineer (Texas)

PROFESSIONAL SOCIETIES:

Member: ASME and ASTM Committee E-08 on Fatigue and Fracture of Materials

EXPERIENCE:

July 1996 - Present CONSULTING ENGINEER, Houston, Texas

Independent Consulting Engineer

Sole proprietor of a consulting practice specializing in applied mechanics, material behavior studies, fracture mechanics, fatigue and stress analysis, structural design and finite element analysis.

April 1995 - June 1996 ENGINEERING CYBERNETICS INCORPORATED, Houston, Texas

Senior Consulting Engineer

Performing engineering analysis on a consulting basis using computer software marketed by the company. Provide technical support for customers using the software sold through the company. ECI is a "value added reseller" of engineering software and computer hardware.

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February 1995 - April 1995 CH&A CORPORATION, Houston, Texas

Consulting Engineer

Performing engineering analysis and consulting services for insurance company investigations and expert witness services for attorneys involved in litigation. Subject matter included mechanics of materials analysis related to fatigue, fracture mechanics, and creep of materials.

August 1994 - January 1995 CONSULTING ENGINEER, Houston, Texas

Independent Consulting Engineer

Sole proprietor of a consulting practice specializing in applied mechanics, material behavior, fracture mechanics, stress analysis and structural design. Designed structural support tower for CAMCO coiled tubing drilling operation on the North Slope, Alaska

1988 - 1994 ABB VETCO GRAY INC., Houston, Texas

Analysis Manager, Analysis and Testing Services Group

Managed a group of engineers and technicians performing stress analysis on mechanical equipment and structures. The group provided analysis services for ABB Vetco Gray groups and external customers on a contract basis. Services included fundamental stress analysis calculations, finite element analysis, fatigue and fracture evaluations, ASME and API code interpretation. This group also was responsible for maintaining hardware and software for the computer network used by the Western Hemisphere R & D functions.

1986 – 1988 CORTEST LABORATORIES, INC., Cypress, Texas

Engineering Leader, Engineering Mechanics Group

Engineering Mechanics Group consisting of one Engineer and two senior technicians. This group provided fracture mechanics testing and consulting services, stress analysis services, and design and construction of specialized mechanical testing systems. Managed the mechanical equipment portion of a \$350,000 contract for the construction and utilization of a hydrogen gas test facility for material testing.

1984 – 1986 CORTEST APPLIED MECHANICS INC., Cypress Texas

President and Chief Executive Officer

Responsible for total operation of a contract testing and consulting business including marketing, bookkeeping, and conduct of work for customers. The majority of the work performed by this company involved fracture mechanics testing, consulting, and training for customers. The company also designed and constructed several specialized testing systems and provided consulting services for analysis of mechanical equipment failures.

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1982 – 1984 CAMERON IRON WORKS, Houston, Texas

Senior Mechanics of Materials Engineer, Oil Tool Division, Metallurgy Department

Responsible for providing technical consulting and materials data to engineers and management concerning the mechanical behavior of materials. Duties included teaching several in-service courses on fracture mechanics and material behavior. Directed a major project valued at \$500,000 that clearly established a Cameron alloy as the best alternative among several materials for oil field critical service equipment.

1972 – 1982 GENERAL ELECTRIC COMPANY, Schenectady, New York (8 Years) and
ALCOA LABORATORIES, Alcoa Center, Pennsylvania (2 Years)

Positions held during this time period ranged from Engineer to Senior Engineer and Group Leader

Duties during this period included development of fatigue and fracture materials data for design engineers, providing mechanics of materials consulting service and managing an engineering properties testing laboratory. Another assignment involved managing a measurements and diagnostic services group. This group would instrument and measure stresses, loads and temperatures on mechanical equipment or structures. This data was then used to diagnose and correct problems with the equipment.

PUBLICATIONS:

"The Effects of Out-of-Phase Biaxial-Strain Cycling on Low Cycle Fatigue", by S.Y. Zamrik and R.E. Frishmuth, *Experimental Mechanics*, Vol. 13, No. 5, May 1973, pp. 204-208.

"Failure Analysis of Cast Irons Under General Three-Dimensional Stress States", by R.E. Frishmuth and P.V. McLaughlin, *Journal of Engineering Materials and Technology*, Vol. 98, Series H, No. 1, January 1976, pp.69-75.

"Failure of an Experimental Gas Turbine Rotor", by R.E. Frishmuth and D.P. Smith, *Failure Prevention and Reliability* edited by Bennet, Ross and Zemanick, ASME, 1977, pp. 151-164.

"Use of Fracture Mechanics Methods for Establishing Inspection Levels for Turbine Wheels", by R.E. Frishmuth, *Journal of Engineering Materials and Technology*, Vol. 101, No. 1, January 1979, pp. 75-79.

"Temperature Dependent Deformation Mechanisms of Alloy 718 in Low Cycle Fatigue", by T.H. Sanders, Jr., R.E. Frishmuth, and G.T. Embley, *Metallurgical Transactions*, Vol. 12A, June 81, pp. 1003-1009.

"A Fracture Mechanics Based Material Acceptance Method for Oil Tool Equipment", by R.E. Frishmuth, ASME Pressure Vessel and Piping Conference, San Antonio, Texas, 1984, Paper #84-PVP749.

"A Fracture Mechanics Based Inspection Criterion for Internal Walls of Offshore Wellhead Equipment", Offshore Technology Conference, Houston, Texas, 1986, Paper OTC # 5112. (This paper won the Arthur Lubinski award for the best ASME paper given at the conference.)

"Materials Data in the Petroleum Industry - An Overview of Needs" by R.E. Frishmuth, ASME Pressure Vessel and Piping Conference, Chicago, Illinois, July 1986, in Book No. G00349, MPD-Vol. 1 of ASME conference proceedings.

"Advanced Fracture Control Procedures for Deepwater Platforms and Compliant Towers", by P.W. Marshall, J.W. Post, R.E. Frishmuth, and J.L. Grover, Offshore Technology Conference, Houston, Texas, 1990, Paper OTC # 6387.

"Economic Justification for LAN Installation in an Oilfield Equipment Manufacturing Operation", by R.E. Frishmuth and J.A. Gariepy, Seventh SPE Petroleum Computer Conference, Houston, Texas, July, 1992, SPE #24458

"Fracture Mechanics: A Practical Tool for Improving Plant Reliability", by R.E. Frishmuth, Third International Conference on Improving Reliability in Petroleum Refineries and Chemical Plants, Houston, Texas, November 15-18, 1994

"Design, Construction and Use of a Coiled Tubing Drilling Structure for Onshore and Offshore Operations", by R.E. Frishmuth, J.C. Pursell, R.J. Middleton, and C.O. Parker, 1996 Offshore Technology Conference, Houston, Texas, May 3-6, 1996

"Development of a Novel Tieback Connector with High Mechanical Strength Capacity for Spar Floating Production Facilities and Their Production Risers", by H.B. Skeels, J.B. Johnson, B.M. Koleilat, and R.E. Frishmuth, Paper #8574, 1997 Offshore Technology Conference, Houston, Texas, May, 1997

"Hydrotesting Not Required Under New API-653 Procedure" by Steve Caruthers and R. E. Frishmuth, Oil and Gas Journal, January 31, 2000, Pennwell Publishing

"Risk Based Assessment of a 25,000 Ton Ammonia Storage Tank" by Daly, Deis, Frishmuth, McIntyre, Paneitz and Smallwood, Process Safety Progress, December 2002, American Institute of Chemical Engineers