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Dr. Mohsin R. Khan

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RULEMAKINGS AND
ADJUDICATIONS STAFF

EDUCATION: B.S., Mathematics, Christ Church College, Kanpur, India (1970)
B.S., Mechanical Engineering, Harcourt Butler Technological
Institute, Kanpur, India (1974)
M.S., Mechanical Engineering, Clarkson College of Tech., USA (1975)
Ph.D. Solid Mechanics (Structures), Clarkson College of Tech., USA (1978)

REGISTRATION/MEMBERSHIP:

Professional Mechanical Engineer - State of California
American Society of Mechanical Engineer
IEEE-344 Committee (Current Member)
EPRI- STERI (1995-96)

HONORS: Award of Merit from Bechtel Power Corporation
Received several Performance Recognition awards at Pacific Gas & Electric
Company

EXPERIENCE: Altran Corporation, San Francisco - Engineering Manager

- Mohsin is the Manager of Altran's Structural Mechanics group in San Francisco. In his current assignments, his responsibilities include both providing technical and project management leadership. The Structural Mechanics group includes structural analysis and design, piping analysis and design, and equipment analysis and design and testing functions.
- Performed Structural Probabilistic Risk Assessment of MHM Crane for the Dry Cask Project. This is for the DOE's Hanford site in Washington.
- Providing equipment seismic specifications for testing and design review support for the CVDF (Cold Vacuum Drying Facility) equipment for the Dry Cask Project. This is also for the DOE's Hanford site in Washington.
- Provided design and analysis for the Indian Point 1 Power Plant's Spent Fuel Pool project. This involved in providing a steel liner and the leak chase system to the existing pool walls to protect it from leakage; designing a partition wall with a water tight steel gate and redesigning the new Fuel Racks. Detailed dynamic analyses of the Spent Fuel Pool Racks using ANSYS program were performed.
- Provided structural design reviews for the Humbolt Bay Power Plant (HBPP) Stack removal project. This involved in assessing the effect of soil pressure on the existing building structural walls due to placement of heavy crane loads during the stack removal.

- Provided design upgrade for the DCPD Refueling Water Storage Tank Project. This involved several dynamic analyses of various piping branch lines, several tank analyses, and structural support evaluations.
- Provided inspection procedures to comply with the ASME section IWE and IWL requirements and calculations for the steel liner and concrete wall threshold thicknesses for the DCPD containment.
- Provided engineering support and structural evaluation and design modification in support of DCPD Seismic Gap program.
- Developing a Design Basis Criteria Document for the HBPP Dry Cask/ISFSI project. This design basis criterion will be used by the HBPP for the bid evaluation to select a Dry Cask vendor for the decommissioning purposes.
- Development of the criteria and the specifications for dynamic shake table tests for the RVLIS system. This involved several cabinet finite element analyses and shaker table testing to meet the seismic design bases requirements for the DCPD site. This involved witnessing the shake table tests, identification of problems which develop during the shake table tests, participation in the resolution of them (e.g., design changes to strengthen the components), and interpretation and acceptance of the test results for documentation in engineering calculations.

Pacific Gas & Electric Company, San Francisco (Nuclear Power Generation)

- Principal Engineer, Company's Structural/Equipment Seismic, Vibration and Dynamic Analysis and design expert
- Supervise and provide technical guidance to a group of engineers in the area of vibration and seismic analysis of Mechanical, Electrical, Instrumentation and Controls, and Heating and Ventilation equipment for Diablo Canyon Nuclear Power Plant (DCPP).
- Developing Finite Element models of equipment and perform computer analyses to qualify the equipment for DCPD design bases seismic events. This involves reviewing the results of the analyses for completeness accuracy, validity and documenting the results in Design Calculations.
- Extensive use of computer programs - STRUDL, ANSYS, BSAP, SAP90, SAP2000 and several in-house programs. Occasional use of NASTRAN and STARDYNE.
- Development of the criteria and the specifications for dynamic shake table tests for instrumentation, electrical devices, and control panels/cabinets to assure that the tests will envelope the specific load conditions that the components would be subjected to during design bases seismic events at DCPD. This involves witnessing the shake table tests, identification of problems which develop during the shake table tests, participation in the resolution of them (e.g., design changes to strengthen the components), and interpretation and acceptance of the test results for documentation in engineering calculations.

- Provide extensive technical support around the clock including weekends to resolve construction constraints/problems during the design implementation and provide alternative design solutions acceptable to client (DCPP) without increasing the outage cost and duration
- Provide technical interface with Westinghouse and other vendors in the area of NSSS equipment, structural dynamic/seismic qualification. This requires monitoring the vendor's technical work, cost and also help in meeting the stringent project schedules.
- Provide technical support including seismic calculations and their interpretation to Diablo Canyon's Long Term Seismic Program consultants for Mechanical, Electrical, I&C, and HVAC equipment. This involves Probabilistic Risk Assessments and Fragility Evaluations.
- Performed structural dynamic analyses to qualify the Manipulator and the Spent Fuel Pool Bridge Cranes for DCPP units 1 and 2. This involved modifying the cranes for the upgrade purpose and to meet high seismic demand loads.
- Provide structural/seismic evaluation for the dedication activities for Replacement Parts Program. This is an extensively tedious and technically involved process and poses a constant challenge to accept commercially procured parts to be used at Diablo Canyon Nuclear Power plant which is in a very high seismic zone.
- Perform LOCA (Loss of Coolant Accident Analysis) and Seismic analyses for Containment Isolation Purge and Exhaust valves.
- Involved in review of Dynamic Qualification of High Density Spent Fuel Racks for Diablo units 1 and 2. Also performed an independent Finite Element analyses to check vendor's work during the licensing hearing process due to outside intervenors. Provided expert testimony on High Density Spent Fuel Rack design.
- Seismic evaluation of as-found conditions of equipment which deviate from the original design bases. For example: electrical cabinets and panels with loose and missing mounting hardware, and damaged equipment and equipment supports. These events are immediately reportable to the NRC if the as-found conditions compromise the public safety. Therefore, prompt resolution of these problems becomes extremely important. The resolution process often times requires unique dynamic non-linear analyses and obtaining test information from various sources.
- Team member of the Diablo Canyon and Humbolt Bay Power Plant's Dry Cask Project. He has unique technical and business experience in the site and vendor selection process for the Dry Cask project. He is familiar with all of the nation's leading Dry Cask vendors, their design features, and their limitations.
- Managed the equipment and structural seismic design and dynamic testing of many capital projects at DCPP. In addition to his work on Dry Casks, he was involved in the Underground Diesel Fuel Tank replacement project, 6th Diesel Generator addition project, Vital 4kv switcher replacement project, Inverter Replacement Project, 125V Battery Replacement Project, Electrical Relays Replacement Project, Various Pump-Motor Replacement Project, Main Annunciator Replacement Project, Main Control Board Modification Project due to Human Factor Effects, Post Accident Monitoring Equipment Replacement Project, and replacing the

buried piping for the ultimate heat sink. Each of these projects was in millions of dollar, and posed significant technical and licensing challenges.

BECHTEL POWER CORPORATION, San Francisco

- Susquehanna Nuclear Power Plant (Mark II) Design evaluation of Containment Building. Structural analysis of box beam platforms, pipe whip restraints, diaphragm slab, hangers, quenchers, etc., using STRUDL, BSAP, ANSYS and other in-house computer programs.
- Equipment (Dynamic) Qualification Group (EQG) Worked on Limerick, Susquehanna-Mark II, Hope Creek-Mark I, Diablo Canyon-PWR, Nuclear Power Plants.
- In charge of all computer activities (Mainframe/Micros) of the group.
- Developed a computer program "BSEIM" that generates artificial random time histories from a given floor response spectra for UNIVAC 1100 series mainframe computer.
- Extensive use of AISC Code and ASME Code. Section III and VIII, and IEEE-344-75 Standard for dynamic qualification of equipment.
- Use of Vibration Testing to qualify Electrical, HVAC and Mechanical Equipment such as cabinets, terminal blocks, valves, dampers, operators, and pumps, etc., per IEEE-344-75.
- Successfully defended NRC Audits on non-NSSS Mechanical Equipment for Diablo Canyon Unit 1 Project.
- Reviewed equipment dynamic qualification of Westinghouse (NSSS) supplied Mechanical Equipment for Diablo Canyon Project.
- Dynamic Analysis (Response Spectra and Time-History) and Static Analysis (Thermal Load, Dead Weight, Pressure, and Nozzle Loads) for a variety of Class I equipment, i.e., valves, component cooling water surge tanks (horizontal), boric acid tanks (vertical), safety injection pump and motor, auxiliary feedwater pumps and motors, auxiliary feedwater turbine, diesel generators and radiators, silencers, starting air receiver and turbo charger tanks, priming tanks, lube and diesel oil filters, strainers, containment fan cooler boxes, dampers, heat exchangers, electrical cabinets, radwaste compressors, coolers, and decay tanks, containment hydrogen purge exhaust and supply filters, steam generator blowdown tanks and coolers. Portable fire pumps, and condensers, etc.
- Extensive use of computer programs - STRUDL, ANSYS, BSAP, NASTRAN, STARDYNE, and in-house Bechtel programs.
- Involved in finite element model review for Seismic and Impact Analysis of Vacuum Breaker Valves for the Downcomers of Susquehanna, Limerick and Shoreham Nuclear Power Plants (Vendor - AGCO).
- Interaction with vendors and review of vendor analysis or test reports; review and writing of design or test specifications; coordination with the project and field about design modifications;

- coordination with procurement in issuing purchase orders to outside vendors for analysis and testing.
- Supervised a group of 25 engineers; responsible for the review technical guidance and approval of calculations; manpower planning and man-hour estimates; scheduling and employee performance evaluations; finalizing the equipment qualification packages for NRC audit.
- Developed a General Finite Element Structural Analysis Code MICROSAC for structural analysis for Microcomputers (Static and Dynamic Analysis Capability).

Clarkson College of Technology – Assistant Professor

- Taught Particle Dynamics, Static, Strength of Materials, Machine Design as undergraduate courses.
- Taught Finite Element Methods, Theory of Elasticity and Structural Dynamics as graduate courses.
- Author of several papers in ASME, AISC, and AIAA (American Institute of Aeronautics and Astronautics) Journals.
- Developed several special finite element computer programs, structural optimization programs, kinematic analysis programs.
- In charge of all computer activities in the department of Civil and Environmental Engineering.
- Supervised three graduate students towards their M.S. thesis. Thesis topics involved development of Structural Optimization techniques to design Beams, Frames, Aircraft wing structures, Transmission Towers, etc., under stress, displacement, and natural frequency constraints. Also, a special finite element was developed to analyze horizontally curved beams under warping effects using flexibility method.

PUBLICATIONS:

KHAN, M. R. and WILLMERT, K. D., "Vibration Analysis of Mechanisms Using Constant Length Finite Elements," ASME, Paper No. 76-WA/DE-21, 1976.

KHAN, M. R. and WILLMERT, K. D., "General Kinematic Analysis Of Planar Mechanisms Consisting of Four Bar Chains and Slider Cranks," A User Manual, Department of Mechanical and Industrial Engineering, Clarkson College of Technology, Potsdam, N.Y., Report No. MIE-030.

KHAN, M. R. and WILLMERT, K. D., and THORNTON, W. A., Automated Analysis/Design of High Speed Planar Mechanisms," Proceedings of the 5th OSU Applied Mechanisms Conference, Oklahoma, pp. 21-1 to 21-9, November 1977.

KHAN, M. R., WILLMERT, K. D., and THORNTON, W. A., "A New Optimality Criterion Method for Large Scale Structures," Proceedings of the AIAA/ASME 19th Structures, Structural Dynamics and Materials Conference, pp. 47-58, April 1978.

WILLMERT, K. D., THORNTON, W. A., and KHAN, M. R., "A Hierarchy of Methods for Analysis of Elastic Mechanisms with Design Application," ASME Paper No. 78-DET-56, 1978.

THORNTON, W. A., WILLMERT, K. D. and KHAN, M. R., "Mechanism Optimization Via Optimality Criterion Techniques," Trans. ASME, Journal of Mechanical Design, Vol. 101, No. 3, July 1979, pp. 392-397.

KHAN, M. R., THORNTON, W. A., and WILLMERT, K. D., "Optimality Criterion Techniques for Structures with Multiple Design Variables per Member," Proceedings of the AIAA/ASME/ASCE/AHS 20th Structures, Structural Dynamics, and Materials Conference, pp. 87-95, April 1979.

KHAN, M. R., WILLMERT, K. D., and THORNTON, W. A., "An Optimality Criterion Method for Large Scale Structures," AIAA Journal Vol. 17, No. 7, pp. 753-761, July 1979.

KHAN, M. R., WILLMERT, K. D., and THORNTON, W. A., "A Computer Program Package for Large Scale Structural and High Speed Mechanism Design," Proceedings of the Engineering Software Conference at the University of Southampton, England, September 1979.

SYED, M. I., WILLMERT, K. D., and KHAN, M. R., "Optimality Criteria Techniques Applied to Structures Composed of Different Element Types," Proceedings of the AIAA/ASME/ASCE/AHS 21st Structures, Structural Dynamics and Materials Conference, May 1980, pp. 345-351.

KHAN, M. R., "Optimality Criterion Techniques Applied to Frames Having Nonlinear Cross-Sectional Properties," Proceedings of the AIAA/ASME/ASCE/AHS 22nd Structures, Structural Dynamics, and Materials Conference, pp. 233-241, 1981.

KHAN, M. R., and WILLMERT, K. D., "An Efficient Optimality Criterion Method for Natural Frequency Constrained Structures," Journal of Computers and Structures, Vol. 14, No. 5-6, pp. 501-507, 1981.

KHAN, M. R., and AINSO, H., "Optimal Design of Nonplanar Diaphragms," A Technical Report for Bendix Corporation, Utica, N.Y., 1979.

AINSO, H., and KHAN, M. R., "Effects of Rim and Hub Flexibility During Axial Loading of Diaphragms," A Technical Report for Bendix Corporation, Utica, N.Y., 1980.

KHAN, M. R., "A General Computer Program for the Beams, Frames and Trusses - A User's Manual," Department of Civil and Environmental Engineering Department, Clarkson College, Potsdam, N.Y. 13676, Report Number 81-3, August 1981.

KHAN, M. R., "A Computer Program for Optimum Design of Natural Frequency Constrained Structures," Department of Civil and Environmental Engineering, Clarkson College, Potsdam, N.Y. 13676, Report Number 81-2, August 1981.

KHAN, M. R., "Optimality Criterion Techniques Applied to Frames Having Nonlinear Cross-Sectional Properties," Department of Civil and Environmental Engineering, Clarkson College, Potsdam, N.Y. 13676, Report Number 81-1, August 1981.

KHAN, M. R., and WILLMERT, K.D., "Finite Element Quasi-static Deformation Analysis of Planar Mechanisms With External Loads Using Static Condensation," ASME Paper No. 81-DET-104.

WILLMERT, K. D., JENG, K. K., MONSEF, M., and KHAN, M. R., "Application of Optimality Criterion Methods to Member Lengths and Cross-Sectional Properties of Frame Structures," Proceedings of the AIAA/ASME/ASCE/AHS 23rd Structures, Structural Dynamics and Materials Conference, AIAA-82-0720-CP, May 1982.

ZACHAROPOULOS, A., WILLMERT, K. D., and KHAN, M. R., "An Optimality Criterion for Structures with Stress, Displacement and Natural Frequency Constraints," Proceedings of the AIAA/ASME/ASCE/AHS 24th Structures, Structural Dynamics and Material Conference, AIAA-83-0939, May 1983.

KHAN, M. R., "BSEIM Computer Program For Generation of Random Synthetic Time Histories From The Floor Spectra," Rev. 1, Civil/Structures Group, Bechtel Power Corporation, January 1984.

KHAN, M. R., "Optimality Criterion Techniques Applied to Frames Having General Cross-Sectional Relationships," AIAA Journal, Vol. 22, No. 5, pp. 669-676, May 1984.

KHAN, M. R., "Improved Method of Generation of Artificial Time Histories, Rich In All Frequencies, From Floor Spectra," Earthquake Engineering and Structural Dynamics Journal, Vol. 15, pp. 985-992, 1987.

KHAN, M. R., "User and Verification Manual For MICRO-SEIM Computer Program," September 1988, Pacific Gas & Electric Company.

KHAN, M. R., "Users' Guide, Theory Verification for GENRRS

Computer Program," February 1989, Pacific Gas & Electric Company.

KHAN, M. R. and SHAKIBNIA, B., "Generic Fragility Seismic Testing of Breakers For Diablo Canyon Power Plant," Proceedings of the 1990 ASME Boiler & Pressure Vessel Conference, Book No. H00616.

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KHAN, M. R., CHEN, WAYNE W.H., SHAKIBNIA, B, AND DAVIS, R.D. "Torque Test For Bolts/Screws In Maintaining Equipment seismic Qualification," Proceedings of the ASME, PVP Vol. 56-2, Seismic Engineering, Vol. 2, pp. 41-45, 1993.

KHAN, M. R., CHEN, WAYNE W.H. AND CHU, W. S., "Seismic Qualification of a Commercial Grade Diesel Generator In a High Seismic Zone," Proceedings of 4th International Topical Meeting on Nuclear Thermal Hydraulics, Operations and Safety., Vol. 1, pp. 5D-1 - 5D-5, April 1994.

PRESENTATIONS

"Vibrational Analysis of Mechanisms Using Constant Length Finite Elements," ASME Winter Annual Meeting, New York, December 1976.

"Optimality Criterion Techniques Applied to Mechanical Design," ASME Design Engineering Technical Conference, Chicago, September 1977.

"Automated Analysis/Design of High Speed Planar Mechanism," 5th OSU Applied Mechanism Conference, Oklahoma, November 1977.

"A New Optimality Criterion Method for Large Scale Structures," AIAA/ASME 19th Structures, Structural Dynamics, and Materials Conference, Maryland, April 1978.

"A Hierarchy of Methods for Analysis of Elastic Mechanisms with Design Applications," ASME Design Engineering Technical Conference, Minneapolis, September 1978.

"Mechanism Optimization Via Optimality Criterion Techniques," ASME Design Engineering Technical Conference, Minneapolis, September 1978.

"Optimality Criterion Techniques Applied to Structures with Multiple Design Variable per Members," AIAA/ASME/ASCE/AHS 20th Structures, Structural Dynamics, and Materials Conference, St. Louis, April 1979.

"Optimality Criteria Techniques Applied to Structures Composed of Different Element Types," AIAA/ASME/ASCE/AHS 21st Structures, Structural Dynamics, and Materials Conference, Seattle, Washington, May 1980.

"Optimality Criterion Techniques Applied to Frames Having Nonlinear Cross-Sectional Properties," AIAA/ASME/ASCE/AHS 22nd Structures, Structural Dynamic, and Materials Conference, Atlanta, Georgia, April 1981.

"Finite Element Quasi-Static Deformation Analysis of Planar Mechanisms With External Loads Using Static Condensation," ASME Design Engineering Technical Conference, Hartford, Connecticut, September 1981.

"Application of Optimality Criterion Methods to Member Lengths and Cross-Sectional Properties of Frame Structures," AIAA/ASME/ASCE/AHS 23rd Structures, Structural Dynamics, and Materials Conference, New Orleans, Louisiana, May 1982.

"An Optimality Criterion for Structures With Stress, Displacements and Natural Frequency Constraints," AIAA/ASME/ASCE/AHS 24th Structures, Structural Dynamics and Materials Conference, Lake Tahoe, Nevada, May 1983.

"Generic Fragility Seismic Testing of Breakers For Diablo Canyon Power Plant," 1990 ASME Boiler & Pressure Vessels Conference, Nashville, Tennessee, July 1990.

"Nonlinear Interaction Analysis for Seismic Equipment qualification," ASME Pressure Vessels and Piping Conference, New Orleans, Louisiana, June 1992.

"Seismic Qualification of Multiple Interconnected Safety Related Cabinets In a High Seismic Zone," 12th International Conference on Structural Mechanics in Reactor Technology, Stuttgart, Germany, August 1993.

"Torque Test For Bolts/Screws In Maintaining Equipment Seismic Qualification," ASME Pressure Vessels and Piping Conference, Denver, Colorado, July 1993.

"Seismic Qualification of a Commercial Grade Diesel Generator In a High Seismic Zone," 4th International Topical Meeting on Nuclear Thermal Hydraulics, Operations and Safety, Taipei, Taiwan, 1994.

"Failure Analysis of Globe Control Valves with Spring-Diaphragm Actuator for Nuclear Power plant Applications, " Topical Meeting on Nuclear Thermal Hydraulics, Beijing, China, April 1997.

"Seismic Qualification of New Underground Diesel Fuel Tanks at Diablo Canyon Nuclear Power Plant Site, " ASME Pressure Vessels & Piping Division Conference, Orlando, Florida, 1997.

NUCLEAR REGULATORY COMMISSION

Exhibit No. _____ Official Exh. No. 119
In the matter of PPS
Staff _____ IDENTIFIED ✓
Applicant _____ RECEIVED ✓
Intervenor ✓ _____ REJECTED _____
Other _____ WITHDRAWN _____
DATE 5/7/02 - () Witness _____
Clerk V. McDaniel