EDUCATION

Ph.D.: Nuclear Engineering, University of Maryland 1986
M.S.: Mechanical Engineering, MIT 1978
M.S.: Nuclear Engineering, MIT 1978
B.S.: Mechanical Engineering, Tehran University 1974

ACADEMIC EXPERIENCE

Adjunct Professor: **University of Maryland, College Park, MD - 1988 - 2025**

GRADUATE COURSES – 1988 - 2015:

ENNU 648K "Nuclear Reactor Physics & Engineering",.....Spring 2010, 11, 12, 13, 14, 2015
ENNU-648F "Advanced Nuclear Systems & Severe Accident" .....Fall 2009, 10, 11, 12, 13, 14, 2015
ENME-648K "Nuclear Reactors Severe Accident" .....Fall 2008
ENNU-840 "Thermal hydraulic Design of Nuclear Reactors".....Fall 1988, 90, 91

UNDERGRADUATE COURSES – 1988 - 2025

ENME-430, "Fundamentals of Nuclear Engineering: .....2020 through Fall 2025
ENME-431, "Nuclear Reactor Systems & Safety".....Spring 2021, 2022, 2023, 2024, 2025
ENME-433, "Nuclear Reactor Design" .....Spring 2021, 2022, 2023, 2024, 2025
ENME-489E, "Nuclear Reactor Systems & Safety" .....Spring 2008 & 2010
ENNU-485, "Thermal hydraulics of Nuclear Reactors" .....Spring 2004, 05, 06
ENNU-480, "Reactor Core Design" .....Fall 2003, 04, 05
ENNU-455, "Nuclear Reactor Engineering II".....Fall 1993, Spring 1994, 2003, 2005
ENNU-450, "Nuclear Reactor Engineering I" .....Spring 1993
ENNU-460, "Nuclear Heat Transport" .....Spring 1989, 1991, Fall 1993
ENME-217, "Thermodynamics" .....Spring 1988, Fall 1992
ENNU-215, "Introduction to Nuclear Technology".....Fall 1989, 1992
ENME-342, "Fluid Mechanics".....Fall 1990
ENCH-425, "Heat Transfer".....Fall 1988

PUBLICATION - BOOKS

Massoud, M., "Engineering Thermofluids" Springer. ISBN 10 3-540-22292-8, 2005.

Todreas, N. E., M. S. Kazimi and M. Massoud, "Nuclear Systems", Vol. II, Elements of Thermal Hydraulic Design, 2nd Ed., Jan. 2022

PUBLICATION - JOURNAL & CONFERENCE, 2013 - 2016

Modarres, Mohammad, Taotao Zhou and Mahmoud Massoud, 2016, "Advances in Multi-Unit Nuclear Power Plant Probabilistic Risk Assessment", Journal of Reliability Engineering and System Safety

Massoud, M. 2013, "Calvert Cliffs Containment Response to an Extended Loss of AC Power", PWROG, Baltimore, MD. August 12, 2013

Massoud, M. 2013, "LOCA Break Spectrum Analysis with GOTHIC for GSI-191," EPRI SAFETY TECHNOLOGY WEEK, Washington D. C., June 3-7, 2013

BOOK REVIEW – 2014 - 2015

1) Todreas, N. E. & M. S. Kazimi. "Nuclear Systems", Volume 1, 2nd Ed. CRC Press. 2012

2) Robert Masterson, "Nuclear Reactors Physics". CRC Press 2015

3) Ochkov, Valery, Konstantin Orlov and Volodymyr Voloshchuk . "Thermal Engineering Studies with Excel, Mathcad, and Internet". To be published. Springer 2016

SOFTWARE APPLICATIONS

- AREVA's XCOBRA-IIIC and S-RELAP
- NRC's CONTEMPT4/MOD6 for thermal hydraulic analysis of containment
- Combustion Engineering's CONTRANS for containment response analysis
- Bechtel's COPATTA for containment response analysis
- EPRI's GOTHIC for thermal hydraulic analysis of containment
- EPRI's RETRAN for thermal hydraulic analysis of reactor coolant system
- EPRI's MAAP for degraded core and severe accident analysis
- University of Kentucky's KYPIPE for flow distribution in piping

SOFTWARE DEVELOPMENT

- NPA: Thermal hydraulic simulation of integrated reactor system and containment
- SGTRAN: Simulation of steam generator response to feedwater events
- PZTRAN: Two region non-thermal equilibrium model for pressurizer response analysis
- HXTRAN: Simulation of transients in water-cooled heat exchangers
- COPRAT: Iteration free simulation of containment response to thermal loads
- BORON: Determination of reactor coolant boron dilution throughout a fuel cycle
- SIT: Computer simulation of accumulator discharge into reactor coolant system
- SPRAY: Computer simulation of containment spray system dynamic response
- FLOOD: Dry Shielded Canister Response to Off-load conditions
- TOOLKIT: Engineering software for thermodynamic, fluid mechanics, and heat transfer
- LEAK: DSC leak rate in molecular or continuum dominant regime
- TSV_TBV: Condenser Pressurization for Reactor Trip & Stuck Open TBV Given LOOP

INDUSTRIAL EXPERIENCE

ENGINEER IV - NPower Solutions, LLC - Feb. 2024

- Rolls Royes Small Modular Reactor system and containment response to Design Basis Accidents - LB LOCA & MSLB.
- Constellation Energy Group – Analysis of Rapid Containment Cooldown for GSI-191

PRINCIPAL ENGINEER - Information System Laboratories, Inc., 2015 - 2019

- NUSCALE Power, Mass & Energy, Containment Vessel, and Transient Analyses
- KOREA APR1400, RCS and Containment response to LOCA & MSLB, GSI-191
- Duke Power, Brunswick License Amendment Request for Core Operating Limits
- TVA, Browns Ferry, ATRIUM 10XM fuel design transition
- Shearon Harris License Amendment Request, change to the reactor trip system setpoint
- PG&E, Diablo Canyon, Using BEACQN Core Monitoring & Operations Support System

PRINCIPAL ENGINEER - Enercon/Chicago Bridge & Iron/Allied Power Inc., 2015 - 2018

- Calvert Cliffs GSI-191, Break spectrum analysis and model development for LB-LOCA, CL, minimum and maximum safety injection and HL minimum SI.

PRINCIPAL ENGINEER - Constellation – Exelon Corp.:

Calvert Cliffs Power Plant, - (PWR, CE) CCNPP - 1989 – Dec. 2014

- **Fukushima response**
    1. Containment Cooling during extended loss of AC power (ELAP)
    2. Minimum SG Pressure for AFW Availability during ELAP
    3. RCS Inventory Control, Reflux Cooling during ELAP
- **Subject Matter Expert**, training engineers for defense in depth, accident mitigation, and damage estimation for radiological emergency response plans and preparedness (SAMG)
- **Analysis of Systems:**
    1. Pressurizer (Response to transients, heater removal, PORV & SV operations)
    2. Steam Generator (Heat transfer modeling, tube plugging, tube rupture analysis)
    3. Reactor Coolant Pumps (impeller replacement, pump seizure and natural circulation)
    4. Reactor Core (Flow distribution, fuel rod thermal analysis, core uncover)
    5. Spent Fuel Pool (3-D flow distribution and time to boil)
    6. Containment Building (Thermal hydraulic response to design basis accidents)
    7. High Energy Line Break (HELB, Feedwater and Main Steam Line Break analysis)
    8. Independent Spent Fuel Storage Installation (ISFSI, Cask loading, transfer, housing)
    9. Balance of Plant (Condenser Pressurization for TBV Discharge & Loss of Vacuum)
- **Model Development:**
    1. ECCS flow distribution (HPSI, LPSI, and Containment Spray modeling)
    2. Core Uplift Analysis
    3. Thimble plate design
    4. Thermal hydraulic transients for core reload
    5. Sump strainer & NPSH (GSI-191)
    6. Plant simulator certification
- **Responsible Engineer:**
    1. Developed topical report and obtained NRC's approval for the use of GOTHIC code for containment response analysis to design basis accidents.
- **Lead engineer:**
    1. Thermal hydraulic support of Individual Plant Examination, IPE
    2. Analysis of reactor coolant system and containment response to design basis and beyond design basis events in support of operations, ERO, and regulatory matters

R. E. Ginna Power Plant (PWR, Westinghouse), REG – 2004 – Dec. 2014

- Supported NFPA-805 and other thermal hydraulic issues such as resolution of service water flashing in secondary-side of the containment fan coolers
- Spent fuel pool inspection of oxidation layer thickness of cladding
- Containment Response, License Amendment Request
- FLEX, Fukushima, Containment Response

Nine Mile Point Power Plant (BWR, GE), NMP – 2004 – Dec. 2014

- Resolution of condensation accumulation in the downcomer header
- On-site support of Boiling Water Reactors Safety System Design Inspection (CDBI)
- Analysis of service water room response to fire by MAAP
- Spent fuel pool response to higher decay heat for containment drawdown for NMP1 & NMP2

Byron & Braidwood (PWR, Westinghouse), 2004 – Dec, 2014

- Owner Acceptance of Containment Response to loss of coolant accident (LOCA) and main steam line break (MSLB)

ENGINEERING CONSULTANT – 1979 – 2024

- **Department of Energy (2005, 2024)**, Technical Merit Reviewer for FYs 2005, 2006 and 2024 Nuclear Energy Research Initiative Program
- **University of Maryland**, **Department of Mechanical Engineering (Jan – April, 2015)**, Assisted in the development of model for pattern recognition of multi-unit nuclear plant vulnerability to severe accidents
- **ANSI/ANS-58.2, (2012 – 2013)**, Chairman "Leak Before Break" Working Group
- **Journal of Nuclear Technology (2006),** Technical Review of "*Thermal Hydraulic Design of High Power Density Annular Fuel in PWRs*"
- **First Energy, Davis Besse Nuclear Power Plant (2004)**. Assisted in development of heat sink models for containment response to design basis events
- **Omaha Public Power District, Fort Calhoun Power Station (2001-2003)**. Developed topical report and assisted in obtaining NRC's approval for the use of GOTHIC code for analysis of containment response to LOCA and MSLB
- **Massachusetts Institute of Technology (1986-1987)**. Lead engineer for an Electric Power Research Institute (EPRI) project concerning "Evaluation of Horizontal Steam Generators for pressurized water reactor (PWR) Application"
- **Massachusetts Institute of Technology (2011-2014).** Review of Nuclear Systems
- **University Research Foundation (1984-1985)**. Development of protection models for Calvert Cliffs Nuclear Power Plants vital equipment, DOE's Information System Project
- **Massachusetts Institute of Technology (1985)**. Resolution of NRC question posed to Southern California Edison on Safety Injection Tanks Check Valve. Developed model for check valve chattering and analyzed check valve performance
- **Long Island Lighting Company (LILCO) (1980-1981)**. Development of safety parameter display system for LILCO boiling water reactor (BWR) at Shoreham
- **Pennsylvania Power & Light (PP&L) (1979-1981)**. Safety analysis of Susquehanna BWR power plant for suppression pool response to safety relieve valve discharge

SELECTED PUBLICATION, JOURNAL & CONFERENCE – 1978 - 2012

Massoud, M. 2012, Development of PROBLEMSOLVER software accompanying Nuclear Systems Volume I: Thermal Hydraulic Fundamentals, Second Edition by Neil E. Todreas and Mujid S. Kazimi

Massoud, M. 2007, "A 3-D Model for Collapsing Pressurizer Bubble in a Loop-Fill Scheme," EPRI's GOTHIC advisory Group Meeting, Palo Alto, California

Massoud, M. 2006. "Comparison of Conservative and Realistic Models of Large Dry Containment Fan Coolers Given a Hypothetical Main Steam Line Break," EPRI's GOTHIC advisory Group Meeting, February 8-10, Clearwater, Florida.

Massoud, M. 2006. "Alternative Decay Heat Removal, A 3-D Flow and Temperature Distribution in Reactor Vessel, Refueling Pool, and Spent Fuel Pool for Localized and Distributed Heat Sources Given a Loss of Shutdown Cooling," EPRI's GOTHIC advisory Group Meeting, February 8-10, Clearwater, Florida.

Massoud, M. 2002. "Characteristics of Equivalent Piping System," EPRI's GOTHIC Advisory Group Meeting Minutes, April 25 and 26, Carolina Power and Light, Southport, North Carolina.

Massoud, M. 2001. "An Integrated RCS – Containment Model to Analyze the Loss of component cooling water (CCW)," EPRI's GOTHIC advisory Group Meeting, February 22-23, Glen Allen, Virginia.

Massoud, M. 2001. “RCS Response to SIT Nitrogen Ingress in a SB-LOCA,” EPRI’s GOTHIC advisory Group Meeting, February 22-23, Glen Allen, Virginia.

Massoud, M. 1999. “Application of GOTHIC to the Primary Side of a PWR, Analysis of Once-Through-Core-Cooling,” EPRI’s GOTHIC Advisory Group Meeting, April 28-29, Birmingham, Alabama.

Massoud, M. 1997. “Effect of Time Step Size on Containment Response to a Design Basis Accident,” EPRI’s GOTHIC Advisory Group Meeting, August 28-29, Baltimore, Maryland.

Massoud, M. 1997. “GOTHIC Computer Code Containment Response Analysis, Model Qualification,” Topical Report. Presented to USNRC, March 1997.

Massoud, M. 1997. “Determination of Optimum Dry Shielded Canister Flooding Rate In Support of Off-Load Procedure, 10 CFR Part 72,” EPRI’s GOTHIC advisory Group Meeting, February 26-27, Birmingham, Alabama.

Massoud, M. 1996. “Determination Of Time To Boil For Refueling Pool During A Loss Of Shutdown Cooling With The Upper Guide Structure Installed,” EPRI’s GOTHIC Advisory Group Meeting, February 15-16, Charlotte, North Carolina.

Massoud, M. 1995. “Comparison of GOTHIC and COPATTA Containment Codes for Design Basis LOCA and MSLB,” EPRI’s GOTHIC Advisory Group Meeting, August 10-11, Portland, Oregon.

Massoud, M. 1995. “Prediction of Check Valve Performance in a Depressurization Test of A PWR Safety Injection Tank,” Simulators International XII, Vol. 27, No. 3.

Massoud, M., 1994. “A Transient Model for Determination of Actuation Delay of a Containment Spray System,” XI Annual Simulators Conf. Vol. 26, No. 3.

Massoud, M., 1993. “An Iteration-Free Numerical Scheme for Simulation of Containment Response to Various Thermal Loads,” Simulators X, Vol. 25, No. 4.

Massoud, M., 1992. “Performance Monitoring of Service Water Heat Exchanger.” Proceedings of Second EPRI Balance-of-Plant Heat Exchanger NDE Workshop, Key West, FL (May)

Massoud, M. and J. F. Williams, 1991. “LTOP Analysis for Calvert Cliffs Nuclear Power Plant.” Proceedings of ANS, 15th Biennial Reactor Operations Division, International Conference on Nuclear Power Plant Operations – Ready for 2000, Bellevue, WA, (August)

Massoud, M., 1990. “Analysis of Transients in Parallel and Counter Current Flow Heat Exchangers.” Proceedings of ASME, Winter Annual Meeting, Dallas, Texas, (November)

Massoud, M., 1990. “Simulation of Thermodynamics Processes in Pressurized Subcooled Systems.” Proceedings of the Society for Computer Simulation, Simulators VII, Vol. 22, No. 2.

Massoud, M. and F. J. Munno, 1989. “On Comparison of Models for Simulation of Transients in a PWR Pressurizer.” Proceedings Society for Computer Simulation, Simulators VI, Vol. 21, No. 3,

Massoud, M., 1989. “Simulation of Pump Locked Rotor Resistance in a Model Babcock & Wilcox (B&W) Reactor.” Proceedings Society for Computer Simulation, Simulators VI, Vol. 21, No. 3

Massoud, M., S. P. Kao, and N. E. Todreas, 1988. “Evaluation of Horizontal Steam Generators for PWR Applications” Proceedings of the Third International Meeting on Reactor Thermalhydraulics and Operations, Seoul, South Korea, (November)

Massoud, M. and Y. Y. Hsu, 1988. “Single-Phase Natural Circulation in a Multi-loop PWR Model.” Proceedings of the Third International Meeting on Reactor Thermalhydraulics and Operations, Seoul, South Korea, (November)

Hsu, Y. Y. and M. Massoud, 1986. “A New Treatment of Transition Boiling.” International Journal of Heat and Technology, Vol. 4, No. 3-4

Massoud, M., 1986. “An Analytical and Experimental Investigation of Natural Circulation Transients in a Model Pressurized Water Reactor.” Ph.D. thesis, NUREG/CR-4788

Massoud, M., 1984. “Protection Models for Nuclear Plant Components.” Sandia National Lab., URP-84-0010, ALO-1023

Massoud, M., 1981. Technical Review of Chapter 2 of Heat Transfer and Fluid Flow in Nuclear Systems, Neil E. Todreas, Edited by Henri Fenech, Pergamon Press

Kazimi, Mujid S.; Massoud, Mahmoud 1980. “A Condensed Review of Nuclear Reactor Thermal hydraulics Computer Codes for Two-Phase Flow Analysis.” MIT-EL79-018, http://hdl.handle.net/1721.1/35164

Massoud, M. 1978. “Comparison of Conservative and Best Estimate Heat Transfer Packages With COBRA-IV-I.” N.E. Thesis, Department of Nuclear Engineering, MIT.

ACRONYMS & ABBREVIATIONS

AFW: .....Auxiliary Feedwater
AC: .....Alternate Current
CL:.....Cold Leg
CDBI:.....Component Design Basis Inspection
ECCS: .....Emergency Core Cooling System
ELAP: .....Extended Loss of AC Power
EPRI:.....Electric Power Research Institute
GSI: .....General Safety Issue
HELB:.....High Energy Line Break
HL:.....Hot Leg
HPSI:.....High Pressure Safety Injection
ISFSI: .....Independent Spent Fuel Storage Installation
LB:.....Large Break
LILCO:.....Long Island Lighting Company
LOCA:.....Loss Of Coolant Accident
LPSI: .....Low Pressure Safety Injection
MSLB:.....Main Steam Libe Break
MIT: .....Massachusetts Institute of Technology
NMP: .....Nine Mile Point
NPSH: .....Net Positive Suction Head
NRC: .....Nuclear Regulatory Commission
RCS:.....Reactor Coolant System
PGE:.....Pacific Gas & Electric
PPL: .....Pennsylvania Power & Light
PORV: .....Pilot Operated Relief Valve
SI:.....Safety Injection
SG:.....Steam Generator
SV: .....Safety Valve
TBV: .....Turbine Bypass Valve
TVA: .....Tennessee Valey Authority