



Zuhair M. Ibrahim, Ph.D., P.E., CFEI
Principal

Professional Profile

Dr. Zuhair M. Ibrahim is an expert in thermal/mechanical devices and industrial equipment. He applies mechanical engineering, thermodynamic, and fluid dynamic principles to the investigation of Loss of Containment events and large loss fires and explosions.

He has conducted process safety, risk assessment, design, and performance reviews for a range of equipment in industrial, transportation, consumer equipment, and appliances, and is experienced in evaluating site and equipment-specific procedures, including engineering and regulatory controls designed to mitigate or prevent such events.

He is experienced in evaluating the relationship between equipment design, automation, and operator decisions and practices and leads multidisciplinary teams to assess the integrity of large assets and the potential risk and mechanism of failure. He investigates complex engineering failures by evaluating design and specification documents, process and operations data, alarm logs, available videos and photographs, laboratory test results, examination of physical artifacts, computer modeling and witness interviews in an integrated manner.

Academic Credentials and Professional Honors

Ph.D., Aerospace Engineering, University of California, San Diego, 2007

M.Sc., Management, Rensselaer Polytechnic Institute, 2002

Part-time Lecturer at the Department of Aerospace and Mechanical Engineering.
University of Southern California (USC): *Spring 2018 – Present*

Teaching: Heat Transfer AME 331, Thermal Systems Design AME 430

United Technologies Research Center's Outstanding Technical Achievement Award, *June 2003*

AIAA award for 2nd Place Technical Paper in South-Eastern Student Conference, April 2000



Licenses and Registrations

Certified Fire and Explosion Investigator (CFEI) in accordance with the National Association of Fire Investigators (NAFI) National Certification Board per NFPA 921

Registered Professional Mechanical Engineer, California, #M 34508

Registered Professional Mechanical Engineer, Texas, #137621

Registered Professional Mechanical Engineer, Missouri, # 2020007670

Registered Professional Mechanical Engineer, Alabama, # 39002

Remote Pilot Airman Certificate, Federal Aviation Administration

TWIC Card, US Homeland Security – Transportation Security Administration

Commercial Energy Efficiency Auditor, Energy Audit Institute, # EA-12-704

Hazardous Waste Operations and Emergency Response Training (Per Cal-OSHA GISO 5192 and 29 CFR 1910.120); Confined Space Entry Training

Certificate in Helicopter Accident Investigation, University of Southern California

Certificate in Gas Turbine Accident Investigation, University of Southern California

Certificate in Centrifugal Compressor Design and Performance, Concepts NREC

Certified Master Scuba Diver, Professional Association of Diving Instructors—PADI

Presentations and Publications

Ibrahim Z., *An Engineering Investigation of a Recreational Trailer Explosion at Tannehill State Park, Alabama*, Forensic Engineering 8th Congress, ASCE, Austin, TX, December 2018

Ibrahim Z., Garner S., *Gas Turbine Common Issues, Failure Investigations, Root Cause Analyses, and Preventative Actions*, 2016 ASME Power & Energy Conference Charlotte, NC, June 26-30, 2016

Ibrahim Z. *Fire and explosion investigations*. Invited lecture, ME 499, Safe Product Design and Analysis, California State Polytechnic University, Pomona, CA, November 2014, May 2015.



Ibrahim Z, Dennies D. *Gas turbines: Common issues, failure investigation and root cause analysis*. Invited presentation at the 39th Combustion Turbine Operations Technical Forum (CTOTF-2014), San Diego, CA, 2014.

Ibrahim Z, Scott J. *Risk Analysis and Consequence Modeling for a Natural Gas Gathering Pipeline, and Metering Station Installation near Dallas Township, PA*. AIChE 2013 Spring Meeting & 9th Global Congress on Process Safety, April, 2013

Reza A, Ibrahim Z, Tillema D. *Engineering investigation of the 2011 explosion at a fireworks storage magazine in Oahu, Hawaii*. 40th Annual Conference on Explosives and Blasting Techniques, International Society of Explosives Engineers, February 2014.

Ibrahim Z, Stepan J, Slee D, Reza A. *Forensic examination, and failure analysis of a 220 MV step-up transformer fire*. Proceedings of ASME International Mechanical Engineering Convention & Exposition 2013, San Diego CA, November 15–21, 2013. Also: ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering:
(<http://risk.asmedigitalcollection.asme.org/article.aspx?articleid=2515208>)

Reza A, Ibrahim Z, Vaitekunas T. *Investigation and analysis of an explosion at the GOEX Black Powder Manufacturing Facility*. Chemical Engineering Transactions 2013; 31:475–480. DOI: 10.33303/CET1331080. Also in Proceedings, 14th EFCE Symposium on Loss Prevention and Safety Promotion in the Process Industries, Florence, Italy, May 2013. Also published in Loss Prevention Bulletin 235 (IChemE), March 2014.

Reza A, Ibrahim Z. *Investigation of odour fade, and subsequent natural gas explosion at the San Diego Bayfront Hilton Hotel*. Chemical Engineering Transactions 2013; 31:523–528. DOI: 10.33303/CET1331088. Also in Proceedings, 14th EFCE Symposium on Loss Prevention and Safety Promotion in the Process Industries, Florence, Italy, May 2013.

Ibrahim ZM, Williams FA, Buckley SG, Twardochleb CZ. *An acoustic-energy method for estimating the onset of acoustic instabilities in premixed gas-turbine combustors*. Journal of Engineering for Gas Turbines and Power 2008 Sept; 130.

Reza A, Ibrahim Z. *Natural gas explosions*. Invited presentation to the Sempra Utilities Adjusters Training, October 2008.

Ibrahim ZM, Williams FA, Buckley SG, Twardochleb CZ. *A method for estimating the onset of acoustic instabilities in premixed gas-turbine combustors*. ASME Turbo Expo, Montreal, Canada, 2007.



Ibrahim ZM, Williams FA, Buckley SG. *A study of combustion-driven acoustic instabilities in premixed gas-turbines using an acoustic energy framework.* 5th Combustion Institute Meeting, San Diego, CA, March 2007.

Gharavi M, Ibrahim ZM, Borchert M, Williams FA, Buckley SG, Arellano LO. *Tunable diode laser measurements of equivalence-ratio fluctuations for premixed gas-turbine applications.* 5th Combustion Institute Meeting, San Diego, CA, March 2007.

Ibrahim ZM, Williams FA, Buckley SG, Lee JCY. *An acoustic energy approach to modeling combustion oscillations.* ASME Turbo-Expo, Barcelona, Spain, May 2006.

Ibrahim ZM, Landrum DB. *CFD modeling of regenerative cooling in a 15 K Fastrac rocket engine.* AIAA Southeast Region Student Conference, Savannah, GA, April 2000.

Selected Project Experience

Combined Heat and Power (CHP) Plant Performance Modeling

Investigated performance and reliability issues for a CHP unit at a polyethylene foam manufacturer in California:

- Evaluating performance losses at a CHP facility
- Conducting site inspections
- Reviewing design calculations
- Modeling the power plant using Thermoflow suite (GT-Pro, GT- Master, and PEACE)
- Identifying design, component, and maintenance related issues

Root Cause Investigation of a Gas Turbine Compressor Failure

Investigated premature degradation in the performance of a 7FA unit in Nevada. Tasks included:

- Carried boroscope inspections
- Document compressor removal, and disassembly
- Identify components for metallurgical examination
- Review historical data for trends
- Witness metallurgy examination
- Identify likely root cause, and provided recommendations



Transformer Fire

Investigated the explosion of a 220 MV Hyundai transformer. The fire continued for 27 hours fueled by approximately 11,000 gallons of dielectric Hytran oil. The investigation was carried per C57.125 "Guide for Failure Investigation, Documentation, and Analysis for Power Transformers and Shunt Reactors." Tasks included:

- Preparation / Information Gathering
- Onsite inspection
- Internal inspection
- Teardown inspection
- Data analysis, and estimation of the overpressure

Gas Utility Project

Experience in the gas pipeline industry including a 5-month effort to assist a large gas utility company with the implementation of a plan to validate the Maximum Allowable Operating Pressure (MAOP) for its gas transmission lines. Tasks included:

- Searching and organizing records relating to pipeline installation and repair
- Development of pipeline features lists (PFLs) and QC methods for ensuring quality
- Performing QC activities for the PFLs.

Odor Loss and Natural Gas Explosion at the San Diego Hilton Bay Front

Investigated a natural gas explosion on May 19th, 2008 at the 5th floor mechanical room. Tasks included:

- Reviewing records of gas metering, and consumption
- Establishing a timeline from gas release to reaching lower explosive limits (LEL)
- Modeling over-pressure within the room
- Reviewing gas odorization, and loss of odor literature
- Estimating the odor adsorption rate in untreated (un pickled) steel pipes

Prior Experience

Director, LPI Inc., 2016-2019

Managing Engineer, Exponent Inc., 2007-2016

Engineering Consultant, Solar Turbines Inc., 2005–2007

Research Engineer, United Technologies Research Center, 2000–2003

Country Consultant, United Nations Development Programme, 2002–2003



Peer Reviewer

- *Journal of Engineering for Gas Turbine and Power*
- *Combustion Science and Technology*

Professional Affiliations

- National Fire Protection Association—NFPA
 - Committee: Internal Combustion Engines and Gas Turbines (NFPA 37)
 - Committee: National Fuel Gas Code (NFPA 54)
- American Society for Testing and Materials—ASTM
 - Committee membership: D18-26 on Hydraulic Fracturing
 - Committee membership: ASTM A01.06.01 on Power Generation and Pressure Vessel Forgings
- The Combustion Institute
- American Institute for Aeronautics and Astronautics—AIAA
- American Society for Mechanical Engineers—ASME
- Institution of Mechanical Engineers—IMECHE