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Engineering & Scientific Consulting

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Professional Profile

Dr. Fessler's areas of expertise include building mechanical systems, gas and liquid flows, heat transfer, thermodynamics, manufacturing, and risk assessment. Dr. Fessler's building mechanical systems work includes investigating heating, ventilation and air conditioning (HVAC), refrigeration, plumbing and piping systems in commercial, industrial and residential buildings.

His HVAC work frequently involves issues such as temperature and humidity control, occupant comfort, indoor air quality, moisture control, equipment failures, construction claims and damage claims. He has particular expertise in investigating temperature/humidity control issues in which high humidity and/or condensation have led to water damage, fungal growth and/or mold contamination. Dr. Fessler has also worked on numerous refrigeration systems and refrigerated storge facilities related to issues such as chiller failures, refrigerant leaks, temperature control issues, ice build-up and condensation. Dr. Fessler also routinely investigates plumbing issues related to water supply, drain/waste/vent lines, and domestic hot water heating,systems, including the causes of leaks in those systems and the resultant leak rates. Typical components and sub-systems studied have included pumps, valves, chillers, fan-coil units, rooftop units, ventilation systems, heat exchangers, compressors, cooling towers, boilers, furnaces, hot water heaters, split systems, variable refrigerant flow systems, chilled beams, ammonia-based refrigeration systems, building automation systems, and specialized process piping.

Dr. Fessler also has significant experience in risk assessment, including risk and reliability analyses of new products and systems that are under development. Such systems have included consumer appliances, medical devices, hybrid vehicles, large-scale energy storage systems, automotive components, security/anti-terrorism technology, telecommunications equipment, and over a dozen large, international oil and gas refinery/storage facilities. Specific analysis techniques used by Dr. Fessler include Preliminary Hazards Analysis (PHA), Failure Modes and Effects Analysis (FMEA), Hazards and Operability (HAZOP) studies, Fault Tree/Event Tree Analysis, Mean Time Between Failure (MTBF) evaluations, Quantitative Risk Assessment (QRA), Reliability, Availability and Maintainability (RAM), and Safety Integrity Level (SIL) studies.

Prior to joining Exponent, Dr. Fessler was an Acting Assistant Professor in the Mechanical Engineering Department at Stanford University, where he conducted research and taught graduate and undergraduate classes in experimental heat transfer and fluid mechanics.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Stanford University, 1995

M.S., Mechanical Engineering, Stanford University, 1991

B.S., Mechanical Engineering, Rice University, 1990

Phi Beta Kappa

Tau Beta Pi

National Science Foundation Graduate Fellowship

Licenses and Certifications

Professional Engineer Mechanical, California, #32049

Professional Engineer, Colorado, #PE-0043557

Professional Engineer, Florida, #PE75868

Professional Engineer, Hawaii, #PE-18649

Professional Engineer Mechanical, Louisiana, #PE.0047514

Professional Engineer, Maryland, #41622

Professional Engineer Mechanical, Nevada, #26620

Professional Engineer, North Carolina, #37568

Professional Engineer, Oregon, #96699PE

Professional Engineer Mechanical, Texas, #98012

Professional Engineer Mechanical, Wyoming, #PE 17248

Certified Smart Card Industry Professional (CSCIP)

GIAC Security Leadership Certification (GSLC)

Publications

Anderson DM, Fessler JR, Pooley MA, Seidel S, Hamblin MR, Beckham HW, Brennan III JF. Infrared radiative properties and thermal modeling of ceramic-embedded textile fabrics. Biomedical Optics Express 2017 Mar; 8(3).

Osteraas J (ed), Fessler J (contributing author). General Guidelines for the Assessment and Repair of Earthquake Damage in Residential Woodframe Buildings. Section 8 Mechanical, Electrical and Plumbing Systems. Consortium of Universities for Research in Earthquake Engineering, CUREE Publication No. EDA-02, February 2010.

McGoran B, Ross B, Nunes S, Buehler C, Reza A, Kemal A, Fessler J, Belanger J. Evaluation of a chemical plant explosion and lessons learned. Proceedings, Chinese Mechanical Engineering Society Annual Meeting and First Annual Meeting of the Chinese Academy of Engineering, Safety and Reliability, Mechanics and Transportation Engineering Division, pp. 252-257, 2006.

Roy CM, Fessler JR, Medhekar S. Managing post-production change. Proceedings, Materials and Processes for Medical Devices Conference, ASM International, St. Paul, MN, August 2004.

Roy CM, Fessler JR, Foulds JR, Latanison RM, Taylor DE. Do all RPV head penetration leaks have the potential to cause head wastage? Proceedings, ICONE-12, 12th International Conference on Nuclear Engineering, Arlington, VA, April 2004.

Elkins CJ, Fessler J, Eaton JK. A novel mini calibrator for thermochromic liquid crystals. Journal of Heat Transfer 2001; 123(3):604-607.

Fessler JR, Eaton JK. Turbulence modification by particles in a backward-facing step flow. Journal of Fluid Mechanics 1999; 394:97-117.

Fessler, JR, Link G, Nickel A, Prinz F. Rapid tooling inserts using shape deposition manufacturing. Materials and Manufacturing Processes 1998; 13(2):263-274.

Fessler, JR, Nickel A, Link G, Prinz F. Functional gradient metallic prototypes through shape deposition manufacturing. Proceedings, Symposium on Solid Freeform Fabrication, University of Texas at Austin, Austin, TX, August 1997.

Fessler JR, Eaton JK. Particle response in a planar sudden expansion flow. Experimental Thermal and Fluid Science 1997; 15:413-423.

Fessler, JR, Merz R, Nickel A, Prinz F. Laser deposition of metals with shape deposition manufacturing. Proceedings, Symposium on Solid Freeform Fabrication, University of Texas at Austin, Austin, TX, August 1996.

Fessler, JR, Kulick JD, Eaton JK. Preferential concentration of heavy particles in a turbulent channel flow. Physics of Fluids 1994; 6(11):3742-3749.

Kulick JD, Fessler, JR, Eaton JK. Particle response and turbulence modification in a fully developed channel flow. Journal of Fluid Mechanics 1994; 277:109-134.

Eaton JK, Fessler JR. Preferential concentration of particles by turbulence. International Journal of Multiphase Flow 1994; 20, Supple:169-209.

Project Experience

Heating, Ventilation and Air Conditioning (HVAC)

Investigated root causes and corrective actions for poor humidity control and/or condensation issues in a variety of applications including high-rise hotels, low-rise hotels, condominiums, laboratories, nursing homes, hospitals, dormitories, museums, athletic facilities, cold storage facilities, warehouses, natatoriums, and single-family residences. Analyses frequently involve considerations such as contribution of design versus construction for the HVAC systems, controls, operational/performance issues, building pressurization, and/or relative contribution of HVAC systems versus building envelope issues.

Investigated construction defect claims related to alleged HVAC design and construction issues, including HVAC load calculations, equipment selection and improper installation at locations in the US as well as internationally.

Investigated and assessed the impact of HVAC work on construction delays, including the contributions from design changes, owner-directed changes and coordination with other trades at locations in the US as well as internationally.

Investigated temperature control/comfort issues, including those related to building glazing systems, in condominiums, office buildings, schools and a mall.

Investigated HVAC issues at data centers including cooling loads, redundancy, leaking cooling coils and humidity control issues leading to corrosion of electronic components.

Investigated root causes of HVAC coil leaks or ruptures in various applications including office buildings, industrial installations, data centers, and apartment buildings.

Investigated the failures of variable refrigerant flow (VRF) systems, including refrigerant leaks from piping assembled using compression fittings.

Investigated root causes of compressor and chiller failures in various applications including nursing homes, schools, cold storage facilities, and hotels.

Performed condition and remaining life assessments of HVAC equipment at hospitals, hotels, office building, and other dwellings.

Performed HVAC equipment assessments after natural disasters (earthquake, hurricane, fire, flood, hail) at office buildings, apartment complexes, hotels and a shopping malls.

Investigated the causes of and repairs to undergrounds air ducts with leaks and groundwater infiltration.

Analyzed the design and performance of HVAC systems in Asia and the Middle East for applications including petrochemical facilities, a shopping mall, a nuclear power plant and an observation wheel.

Performed extensive testing and analysis of performance of large thermal energy storage system that was not meeting the design energy storage capacity. Determined degree of underperformance and source of underperformance via test data.

Performed proactive risk/reliability evaluation of HVAC system designs at 15 large hotel-casinos throughout the country. Made recommendations regarding potential areas to improve reliability and minimize outages due to loss of HVAC systems.

Refrigeration

Investigated leaks and leak rates of ammonia from ammonia based refrigeration systems, including an explosion due to leak of ammonia in mechanical room of a refrigerated food storage facility.

Investigated causes of equipment failures leading to loss of temperature control and product loss at refrigerated and frozen food storage facilities.

Investigated ceiling collapse at a frozen food storage facility due to ice buildup.

Performed risk assessments and failure analyses on compressors for residential and small commercial refrigerators.

Analyzed patents and intellectual property claims related to refrigeration technology.

Plumbing/Piping

Investigated root causes of water leaks/ruptures on water supply/distribution lines, industrial process lines, sewer/waste lines as well as various individual home appliances/fixtures.

Investigated odor issues and/or hydrogen sulfide-related corrosion of drain/waste/vent pipes in various applications such as hotels, condominiums, country clubs, and grocery stores.

Investigated the design and operation of water distribution systems in buildings in which the piping systems have failed, including, for example, copper pipes exhibiting erosion corrosion and polymeric pipes with through-wall cracks. These investigations often include field measurements of the pressure, temperature and flow rates for the water throughout the system.

Investigated alleged plumbing construction defects including improperly sized vents, inadequately sloped or sized drain lines, inappropriate materials, slow hot water delivery times, and leaks,

Investigated the effects of water hammer on various plumbing fixtures with respect to the potential to generate water leaks.

Investigated piping designs at food and cosmetic production facilities. Issues have included process cooling water systems as well as cross-contamination and clean-in-place (CIP) systems for the food products.

Pipelines

Calculated hydrocarbon release rates and total release volumes for numerous large-scale pipeline ruptures based on recorded data, rupture geometry and geography.

Calculated hydrocarbon release rates and total release volumes for numerous smaller (i.e., pinhole) leaks based on hydrostatic test data. Reviewed historical test data to identify line sections where leaks may be occurring.

Risk Assessment

Performed qualitative risk assessments (e.g., PHA, FMEA and HAZOP) on a variety of products/systems including:

- Numerous petrochemical process and storage facilities
- Utility-scale and facility-scale energy storage systems, including those based on batteries and flywheels
- Three different hybrid-electric bus propulsion systems
- Various consumer products (e.g., coffee maker, fitness trackers, consumer electronics)
- Various medical devices (e.g., unique drug delivery devices, surgical devices)
- Novel refrigeration systems and refrigerants
- Automotive fuel pump
- Novel all-in-one computer designs
- Electrical systems for numerous hotel-casinos, two telecommunications centers and a wafer fabrication facility
- Geothermal brine process train
- Anthrax detection device
- Amusement park ride

Performed quantitative risk assessments (e.g., Fault Trees, Event Trees) for a variety of adverse events including:

- Failures of a hybrid-electric propulsion system for passenger cars
- Fires or explosions due to landfill gas under various designs for a proposed landfill site
- Fires or explosions due to unintentional releases of hydrocarbon refrigerants
- Water leaks due to failed plumbing components or fire sprinklers
- Catastrophic failures of a refrigerated cargo container for airliners
- Fires or electrocutions for various consumer electric devices such as plug-in air fresheners and gasoline-powered toys
- Failures of a flywheel-based uninterruptible power supply (UPS) unit
- Production outages at several crude oil and liquefied natural gas (LNG) production facilities
- Pipeline failures and electrical outages due to derailments of railroad cars

Performed Mean Time Between Failure (MTBF) analyses for a variety of products/systems including:

- Numerous telecommunication and networking components
- A wearable computer system for military combat use
- A portable surveillance system for military combat use.

Performed design-stage risk assessments on over a dozen large, international oil and gas storage and refining facilities in the Middle East and Indonesia including:

- Quantitative Risk Assessment (QRA) studies to determine risk contours due to combined effects of various releases and their consequences (e.g., fire, explosion and toxic gas).
- Reliability, Availability and Maintainability (RAM) studies to determine the availability capacity of the facility over a 20 to 30 year lifetime.
- Safety Integrity Level (SIL) studies on required reliability of sensors and other safety devices based on risk level.