NAFE Winter Meeting Technical Program – Saturday, January 5, 2019 – Orlando – Expected Presentations:

MORNING TRACK: GENERAL TOPICS

Author: William Jones, PhD, PE and Jared Giroux, Esq

Title: A Forensic Analysis that Revealed an Attempted Fraud **(9-9:40 am)**

Abstract: The authors were asked to attend an inspection of a failed water line that was the subject of a subrogation claim for approximately $250,000. The inspection facility was surprisingly ill-equipped. The forensic engineer used a portable microscope to photograph the failed component. Following the laboratory inspection, the authors visited the residence where the loss occurred. The water line had broken in an upstairs bathroom over the renovated kitchen and dining area. After leaving the inspection, the authors agreed that this matter should be further scrutinized. The attorney asked his firm's investigator to run a background check on the owner. The engineer carefully examined digitally enhanced photographs of the failed hose, which showed markings characteristic of a sharp-edged cutting tool. An exemplar water line was cut, and the cuts were compared under a microscope. The attorney's background check revealed that the homeowner had been convicted of insurance fraud approximately five years prior to the subject incident. The background check and forensic evidence were provided to the attorneys for the insurance company. The case was dropped. This paper will provide additional details of the case and lessons learned.

Author bio: Dr. Jones has extensive experience in thermal analysis, dynamic analysis, nonlinear analysis, and the design and fabrication of pressure vessels to ASME code. He has served as White House Fellow in 2002-03. He is a Fellow of NAFE, ASME and IAE. He holds a BS, MS, and a PhD — all in mechanical engineering — and has published six books.

Author bio: Mr. Giroux is a partner at Melick & Porter, LLP in the firm's Boston office. His practice focuses on the defense of complex general liability, product liability, premises liability, construction, and professional liability matters in both Massachusetts state and federal court. He serves as national counsel for a large manufacturer on a series of product liability claims across the country.

Author: Michael Stall, PE

Title: Resolving Schedule Delay Claims with Forensic Analysis **(9:40-10:20 am)**

Abstract: The principles of forensic engineering can be applied to evaluation of schedules, daily reports, project status meeting notes and other documentation to determine how and why delays occurred to a project, which parties were responsible for the delays impacting the critical path. In this particular case, a large hospital campus project was completed several months after the contract completion date, and the contractor claimed it was the owner's fault that the delays occurred. The forensic engineer should have sufficient knowledge and experience with project planning, scheduling, and cost estimating to understand the technical basis of the schedule's critical path, the basis of the resource loading and the schedule logic, the validity of the activity durations, the actual sequence of events, and the material issues that affected the critical path.

Author bio: Mr. Stall started in construction in 1972 as an ironworker helper, and (over the next seven years) worked in positions of increasing responsibility through ironworker foreman and craft superintendent. He then attended the

University of Texas at Austin, Texas where he earned a bachelor's of architectural/structural engineering. Upon graduation, he worked for Bechtel in San Francisco on power plant projects throughout the United States. After seven years with Bechtel, Mr. Stall was accepted to the graduate program at Stanford University where he earned a master's in civil engineering. Upon graduation from Stanford, Mr. Stall started work in the disaster recovery industry for a Houston, Texas general contractor. In 1992, Mr. Stall co-founded Dodd Pacific Disaster Recovery, where he helped numerous resort properties in Hawaii recover from Hurricane Iniki and managed recovery from a fire disaster at the United Airlines World Headquarters where more than 300,000 square feet was damaged by fire. In 1998, he founded Managed Response, Inc., which is a licensed professional engineering firm in Texas and a general contractor that specializes in repairing distressed and damaged properties. Mr. Stall has been working as an expert witness for the past 12 years where he has helped resolve disputes involving construction defects, design defects, general construction disputes, and schedule delay claims. Mr. Stall is a registered professional engineer in the State of Texas and has been a member of NAFE since 2016.

Author: Helmut Brosz, PEng

Title: Electrocutions and Downed Power Lines **(10:20-11 am)**

Abstract: A mother, her two sons, family dog, and a friend took their dog out for a walk. They came upon a large puddle that covered most of an intersection in their intended route. The mother walked around the puddle , her two boys entered the puddle barefoot, and were electrocuted. Their friend entered the puddle to help, and he was electrocuted. The dog followed into the puddle, and he was electrocuted. The mother turned around to see her boys face down in the puddle. She entered the puddle to help them, and she was electrocuted. The issues that will be discussed in this case include vegetation management, transformer fuse protection, conductivity of water and soil, human response to electrical currents, and causes of downed power lines.

Author bio: Mr. Brosz is an adjunct professor at Ryerson University and the director of the Institute of Forensic Electro-Pathology. A board-certified forensic engineer since 1970, he has investigated more than 7,000 matters involving electrocutions, electrical failures, injuries and product liability, electrical testing, wildfires of electrical origin, flooded electrical equipment, and transmission/generation/distribution issues. He has an in-house high-voltage and high-current laboratory and field portable electrical test equipment.

Author: C.J. Abraham, PhD, PE

Title: The Kaprun Ski Train: A Disaster Waiting to Happen **(11-11:40 am)**

Abstract: The train was the first of its kind that opened in 1974. It was an underground train inside a mountain. In 1993, the train was modernized, giving it a futuristic appearance. The design involved two trains that balanced each other out and were driven by a powerful electric pulley system, pulling them up and down at the same time. A control room at the top kept sight of the movements of the trains while communicating with the conductor in the front. There was no fuel involved in the movement of the trains. The length of the track was 12,800 feet with 10,800 feet inside the tunnel. The train traveled at a speed of 15.53 miles per hour up an incline of 30 degrees. On the first day of the season, November 11, 2000, at 9 a.m., the high-tech funicular train, the, "Gletsherbahn 2" was ascending up the mountain to the Kitzsteinhorn at the top approximately 1.55 miles away up the incline. Prior to entering the tunnel, a passenger

observed smoke in the attendant's compartment in the rear of the train that was not attended by anyone when it traveled up the mountain. Critical events occurred, and, in 9 minutes, 155 skiers from various parts of the world were overcome by toxic smoke and died — only 12 escaped. How did 12 escape and 155 die? The critical events that occurred will be explained and demonstrated in this paper. The standard of care and state of technology will be shown, documenting the liabilities of the skiing resort, the engineers and the suppliers of equipment installed on the train. This presentation discusses the events that occurred minute by minute, the cause of the incident, the defects in the design that contributed to the demise of the skiers, the differences of the standard of care and technology in Europe and the United States, and the differences in the personal injury laws of Europe and the United States. The undersigned was the only representative from the United States to examine the burned-out train that held the skiers ascending the tunnel and the one that was coming down.

Author bio: Over the last 45 years, Dr. Abraham has been awarded more than 50 patents and has created warnings and instructions for many products and protocols applied and used worldwide. He has consulted with major news channels, NHTSA, OSHA, NIOSH, State of California (CaITrans), New York Transit, Queensborough Bridge Authority, Department of Agriculture, the federal government, office of the United States Attorney, State Attorney General's Offices, and municipalities throughout the United States, Canada and Europe in a variety of technical areas. In addition, he has consulted to major corporations, such as Microsoft, and presents annual seminars at Columbia University School of Mechanical Engineering to the graduating seniors in the areas of products liability, design of products, safety standards in industry, consumer and industrial products. As a result of Dr. Abraham's involvement in personal injury and litigation cases, many products, including recreational and sports activities, have been made safer.

AFTERNOON TRACK 1: GENERAL TOPICS

Author: Rogerio de Medeiros Tocantins

Title: Chemical Incident Analysis Involving Storage of Fertilizer Product **(2-2:40 pm)**

Abstract: A self-sustaining decomposition (SSD) happened in a load of 10,000 tons of NK 21-00-21 fertilizer, bulk stored inside a warehouse in the city of São Francisco do Sul-SC-Brazil. This chemical reaction developed within the fertilizer mass took several days to be controlled, resulting in the evacuation of thousands of residents. The reaction's smoke and the water used to fight against it promoted environmental damages in adjacent water bodies and surrounding vegetation. Small-scale experiments led to the conclusion that the combination of presence of catalytic material and of acidic conditions originated from moisture absorption, acted as protagonists of this chemical incident.

Author bio: Mr. Tocantins graduated with a degree in mechanical engineering from the Federal University of Santa Catarina State-Brazil in 2004, a degree in Forensic Science from Civil Police Academy of the State of Santa Catarina-Brazil in 2009, specialization in Policy and Management in Public Security from the Estácio de Sá University-Brazil in 2013, and specialization in Analytical Reconstruction of Traffic Crash from the Training Center for Research and Reconstruction of Traffic Crashes CE-IRAT-Argentina in 2017. He works as an Official Forensic Scientist of the Government from State of Santa Catarina – Brazil, conducting forensic investigations of crime scenes, specially related with forensic engineering as fire investigations and traffic crash investigations.

Author: Donald Fournier, PE and Edward George, PE

Title: Forensic Engineering Investigation and Analysis of Crack Formation in Acetyl Resin Nuts Used for Water Supply Lines **(2:40-3:20 pm)**

Abstract: Non-destructive and destructive techniques were used to document and model crack formation in acetyl resin nuts used for household toilet water supply lines. The morphologies of creep rupture and overload failure were documented using microscopy and scanning electron microscope. The forensic investigation stemmed from litigation between a homeowner, plumbing contractor, and supplier involving more than 400 fittings in service for approximately two years. In many properly installed fittings, cracks had initiated at the notch created by the sharp end of the base thread and had propagated via plastic creep as predicted by classical mechanics and finite element analysis.

Author bio: Mr. Fournier is a mechanical engineer and one of the founders of Forensic Engineering Technologies located in Orlando. He has worked in R&D, product development, academia, and consulting during a career of 30 years. He's a graduate of the University of Florida and first began work as a forensic engineer in 1992. He serves as an expert in civil and criminal cases in the areas of traffic accident reconstruction, premises claims, and product failure analysis. He is married to Stacy and has four adult children and a grandson.

Author bio: Mr. George has been a Florida PE for 21 years and an AWS Certified Welding Inspector for 10 years. He's a graduate of the University of Florida, with bachelor's and master's degrees in materials science and engineering. Mr. George has more than 27 years of experience in forensic engineering and is the principal of E&S Consulting. He has published papers on metal and polymer failures and has testified in many depositions and trials in cases involving heavy equipment, large truck accidents, surgical equipment, skylight failures, and product failures involving polymers and stainless steel. Mr. George resides in St Augustine Beach Florida with his wife Undine George, Esq., and his trusty chocolate lab, Flora.

Author: Elizabeth Buc, PhD, PE

Title: Fraudulent Water Damage Claim Investigations **(3:20-4 pm)**

Abstract: The release of water into a structure can cause significant damage and is the subject of insurance claims for loss of and/or damage to property and contents. In some cases, mold growth can increase the health hazard and remediation costs. The extent of damage to a structure from a water loss depends on the discharge rate, the location, the duration of release until discovered and contents. There are numerous causes of water damage claims, ranging from corrosion to improper installation and from manufacturing defect to failures resulting from exposure to freezing temperatures. In addition to legitimate causes, there are also fraudulent water loss claims or an intentional release of water into a structure. The purpose of this paper is to describe numerous fraudulent water loss claims and the science required to establish and distinguish the difference between legitimate and fraudulent claims. Examples of fraudulent water loss causes include: application of heat to facilitate separation of a hose from a barb fitting or a solder joint; use of a razor to cut a ferrule from a plastic water supply line; loosened toilet fill valve assembly nuts; alleged separated diverter valve assembly spring kit; and, some toilet tank failures, to name a few. Fraudulent water loss investigations are compared and contrasted with arson investigations with a focus on methodology, evidentiary issues and admissibility for legal action. Case studies are used to demonstrate the practical application of failure analysis methodology.

Author bio: Fire and Materials Research Laboratory is a forensic engineering consulting firm specializing in failure analysis and fire investigation. FMRL's Elizabeth Buc has two degrees in chemistry (BS, MS), two degrees in materials science and engineering (MS, PhD), is a licensed professional engineer in Michigan and Texas, is a certified fire investigator, owns and operates a forensic laboratory with burn facility in Livonia, Michigan, and has more than 20 years of professional experience in loss investigations. She is a voting principal member on four NFPA technical committees.

Author: Gary Presswood, ScD, PE

Title: A Forensic Engineering Analysis of Pedestrian Trips and Falls Subject to Wheelstops in Parking Lots **(4-4:30 pm)**

Abstract: A forensic engineering analysis of wheelstops (wheelstops, parking bumpers, curb stops, etc., by any other name) will reveal such devices are unnecessary and potentially hazardous to pedestrians when wheelstops are installed within parking lots, of which wheelstops are the direct cause of numerous pedestrian trips, falls, and injuries. Wheelstops are rarely (if ever) needed for the effective design of parking lots and can be eliminated entirely, and when desired, replaced with considerably safer site elements. The initial purpose of this presentation is to present a statistical evaluation of wheelstops in the parking lots of various commercial locations throughout much of the United States, as found along a major East-West route, from coast to coast through many major cities. This study will then present improved and beneficial site design techniques and will reveal authoritative sources regarding the ill-advised use of wheelstops. This presentation should result in providing the forensic engineer with credible published and authoritative sources regarding the hazards of wheelstops, a statistical evaluation of relevant sites, a detailed analysis of the improper use of wheelstops and recommended alternatives.

Author bio: Dr. Presswood was first licensed as a professional engineer in Illinois in 1975, and has been registered in Indiana, Florida, Pennsylvania, Nevada, and Arizona. He first obtained an engineering degree from Southern Illinois University, then a master's degree in public administration (MPA) from the University of Nevada, Las Vegas, and a doctorate in Science (ScD) from California Southern University (magna cum laude). In 1992, Dr. Presswood left the dual positions with the City of Las Vegas, Nevada as their city engineer and Deputy Director of Public Works to establish the forensic consultant firm, The Accident Expert.

AFTERNOON TRACK 2: FIRE INVESTIGATION

Author: David Icove, PhD, PE, Elizabeth Buc, PhD, PE, Mark Goodson, PE, and Thomas May, JD

Title: The Status of Arc Mapping **(2-2:40 pm)**

Abstract: In NFPA 921, *Guide for Fire and Explosion Investigations*, the investigative tool known as *arc mapping* is one of the four "pillars" of determining the area of a fire's origin. This paper addresses the usefulness and limitations of arc mapping certain fires. Arc mapping requires first identifying an arc site and having an explanation for its occurrence in the circuit in a three-dimensional space. When carefully applied and its limitations considered, a skillful fire investigator should know when arc mapping is and is not reliable along with factors that can influence the utility of arc mapping. The experienced professional combines field data, field experience and laboratory data in assigning weight to electrical circuit damage in a compartment. Arc mapping can also be misused should the various limitations and exceptions to its use be ignored. This paper describes the virtues and limitations of arc mapping for both the seasoned and novice

practitioners. The discussion includes various contemporary issues, case studies and recent legal decisions, electrical circuit components that can influence how arc mapping data is analyzed and the use of computed tomography in confirming arc sites.

Author bio: Elizabeth C. Buc, Ph.D., PE, CFI, is the owner of Fire and Materials Research Laboratory, LLC, a leading fire engineering and testing laboratory located in Livonia, Michigan. She is a regular contributor and instructor at Fire and Materials, Interflam, International Symposium on Fire Investigation, Science and Technology, NFPA World Safety Conference and Exposition, and the National Association of Subrogation Professionals. A Registered Professional Engineer, and Certified Fire Investigator, Dr. Buc has a PhD in Material Science and Engineering from Wayne State University.

Author bio: David J. Icove, PhD, PE, FSFPE, CFI, DFE is the UL Professor of Practice at The University of Tennessee, Department of Electrical Engineering and Computer Science, Knoxville, Tennessee. He is a retired federal law enforcement agent and the co-author of several textbooks on fire investigation, including *Kirk's Fire Investigation*, considered expert treatises in the field. He is a Certified Fire Investigator, Certified Fire and Explosion Investigator, Registered Professional Engineer, and a Fellow in the Society of Fire Protection Engineers (SFPE) and the National Academy of Forensic Engineers (NAFE).

Author bio: Mark Goodson, PE, is from Denton, Texas. He is a consultant for many ME's offices, as well as commercial and industrial concerns. He has authored more than 40 professional articles. He was the first engineer to serve on the Texas Electrical Board. Mr. Goodson served as a Court Special Master from 1989-1991. He is the EE/ME serving on the Texas Fire Marshal's Science Advisory Workgroup. Mr. Goodson serves on the US Dept. of Commerce NIST /OSAC. In 2015, UL named him as the electrical engineer serving on the NIJ research team on fire forensics. He has testified in excess of 500 instances. Mr. Goodson holds a BSEE from Texas A&M and attended UT Southwestern where he studied forensic medicine. He is a PE in 14 states. Mr. Goodson holds 15 patents. He is also the inventor serving on the USPTO BoD.

Author bio: Thomas R. May, MS, JD has extensive experience in all facets of the fire service industry with more than 29 years of involvement in fire/investigations related fields. He conducts fire/explosion investigations, provides expert witness testimony, and performs *NFPA 921* and *NFPA 1033*-based peer and file reviews for insurance companies and attorneys. Mr. May specializes in cold case fire investigations and is an active author and researcher in the area of forensic fire science and law. He routinely advises Innocence Projects worldwide in matters involving fire-related forensics. In 2008-09, he served in Iraq as a Forensic Fire Investigator for the U.S. Army Corp of Engineers and Task Force SAFE. Mr. May teaches fire-related subject areas as an adjunct professor at Eastern Kentucky University and is a licensed attorney in the State of New Mexico.

Author: Jason McPherson, PE

Title: Forensic Engineering Use of Arc Fault Circuit Analysis/Arc Mapping in a Residential Kitchen Fire Investigation **(2:40-3:20 pm)**

Abstract: A fire occurred in a single-family residence in March of 2016. As a result, a fire investigator was hired by the property's insurance carrier to determine the origin and cause. Based on the O&C's initial investigation, the fire was determined to have originated in the residence's kitchen, but the exact cause had not yet been determined. The author

was hired to assist the lead fire investigator. During the joint scene examination, the author performed an electrical survey and arc fault circuit analysis/arc mapping to assist in the final determination of origin and cause for the fire. The paper will detail these efforts.

Author bio: Mr. McPherson is a licensed Professional Electrical Engineer. He has been active in the field of electrical engineering since 1997. He graduated from Western Michigan University with a bachelor of science degree in electrical engineering. While working in private industry, he designed control systems for assembly machinery, material handling equipment, boilers, and other electrical processes. He has taught electrical investigation classes for U.S. federal, state, local, and private organizations. Mr. McPherson has been involved in forensic investigations since 2006. His investigations have included fire, explosions, personal injury and equipment damage. He has testified as an electrical expert in both depositions and trials.

Author: Curt Freedman, PE

Title: Solar Fires, Melted Vinyl Siding and Other Ramifications from Concentrated Reflected Sunlight from Low-E Glass Windows, Skylights and Atrium Glass **(3:20-4 pm)**

Abstract: Low-E glass windows, also referred to as Insulated Glass Units (IGUs), consist of two glass panes commonly spaced ½ inch to ¾ inch apart filled with Argon gas or dry air along with a reflective metallic coating applied to the interior of the outer pane of glass. Due to a combination of changes in barometric pressure, contraction of the interior gas from reduced ambient temperature, or diffusion of the interior gas resulted in the previously parallel double pane IGUs becoming concave and parabolic-like in shape. The metallic silver coating caused the IGU to be between 30%-65% reflective; the parabolically shaped windows concentrated the reflected light with focal lengths of 15-60 feet. It was determined using a custom-designed light sensor that the concentrated reflected light of 3-times direct sunlight could easily melt vinyl siding and 12-times direct sunlight was capable of igniting fires with corresponding absorbed blackbody temperatures of over 532°F. The investigation determined the position and solar insolation (sunlight) intensity using ASHRAE (American Society of Heating Refrigeration and Air-conditioning Engineers) Clear Sky Equations at any time of day, any day of the year, and any location on the planet. The solar analysis evaluated the reflected solar angle identities using established geometric and trigonometric mathematical theory. The mathematical algorithms were applied with Excel to allow convenient analysis and detailed graphical output. The combination of solar insolation with weather modeling provides a valuable tool for the forensic engineer. This paper also discusses how this methodology can be used to investigate other forensic applications, including damage to roof membranes and asphalt shingles; damage to vehicles; solar glare contributing to vehicle and pedestrian accidents; and shadowing/glare contributing to slip and fall incidents. Fires and building damage caused by concentrated reflective sunlight has become more frequent, but due to limited awareness of this phenomena, many forensic engineers and fire investigators may find this research to be of keen interest. Case study examples for multiple solar fire incidents have been documented to demonstrate the specific methods of approach as well as specialized instrumentation for actual forensic engineering investigations. The intensity of the reflected sunlight was determined to be profoundly dangerous resulting in strict safety protocols for investigators.

Author bio: Mr. Freedman is the president of CMF Engineering, Inc., an engineering consultancy established in 1985 that specializes in forensic engineering, mechanical systems design, building modeling, and energy conservation. He earned a bachelor's degree in mechanical engineering in 1981 from Lehigh University in Bethlehem, PA and a master of science degree in engineering management from Western New England College in Springfield, MA in 1987. He is a registered professional engineer in 11 states, a certified energy manager, certified energy auditor, and is a LEED (Leadership in

Energy & Environmental Design) Accredited Professional. Mr. Freedman has intervened before several Department of Public Utility Commissions throughout New England to promote fairer and more equitable natural gas and electricity rates.

Author: Michael D. Leshner, PE

Title: Pinched Power Cord is Latent Defect Causing Fire When Appliance is Not in Use **(4-4:40 pm)**

Abstract: After a fatal residential fire, witness statements and burn patterns pointed investigators toward an electrically powered upholstered reclining chair as the origin. A search for exemplar recliners identified slightly different designs of the power supply, which converts house current to low-voltage direct current for driving the motors. Although the fire left no direct evidence of its cause, analysis of unburned exemplars uncovered a design defect in the power supply electrical enclosure design, causing damage to every power cord during assembly. The transformers were found to press against the two-conductor power cord, in a location inside the unit that would be concealed after assembly. The newer units did not have this design defect. Investigators developed the hypothesis that over time, the sustained force of the transformer against the cord enabled the insulation to deform such that a short-circuit occurred in the power cord and caused the fire -- even when the recliner was not in use, and even if the house wiring circuit had been protected by a breaker. This paper details the investigation, testing, and findings, including dissenting expert opinions. More importantly, it shows how forensic engineers conduct detective work and apply scientific principles to achieve useful results, sometimes while working well beyond the formal routines and textbook procedures for typical investigations.

Author bio: Mr. Leshner is a second-generation forensic engineer. He served in the US Peace Corps as a science and math teacher in Uganda and returned to complete his BSME at New Jersey Institute of Technology in 1973. He obtained his PE license in 1978 and has been working as a forensic engineer since 1982. He studied combustion as a graduate student at Princeton University and worked for many years in the automotive engine R&D field. Mr. Leshner is the inventor on 16 U.S. patents and held several senior management positions in the R&D field, including Director of R&D for a medical equipment manufacturer. His forensic engineering activities became full-time in 1997, the year he joined NAFE. Ever since presenting his first paper at a NAFE conference in 2002, he has been an active participant in NAFE and served as president in 2017.
