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Chris Lautenberger
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14 October 2021

Suzie Rose
California Office of Energy Infrastructure Safety

Subject: Wildfire Modeling Working Group Application

Ms. Rose,

I am writing regarding your 6 October 2021 presentation entitled “Wildfire Modeling Working Group Details,” because I would like to apply to the wildfire modeling working group that will soon be convened. Some of my relevant experience in this area is summarized below and in my enclosed CV.

California Public Utilities Commission (CPUC) High Fire Threat District Mapping: I co-lead (along with Pacific Gas & Electric and San Diego Gas & Electric) the Peer Development Panel tasked by the CPUC with developing high fire threat districts that identify areas where overhead electrical utilities present elevated or extreme risks of igniting damaging wildland or wildland urban interface fires. This map was adopted by the CPUC for regulatory purposes in 2018 and is currently used to promulgate regulations related to electrical utility fire safety in California.

Next Generation Open Source Wildfire Models for Grid Resiliency: I am currently leading the real-time wildfire spread and risk forecasting component of this \$5M project funded by the California Energy Commission (CEC). This project provides utilities and other stakeholders with real-time forecasts of active wildland fires as well as landscape-scale burn probabilities up to one week in the future. It also models ignition probability, fire size, and impacts from utility-caused fires under forecasted wind and weather conditions to inform proactive de-energization decisions. A beta version of the system has been in testing for two fire seasons and can be accessed at <https://pyrecast.org>, and a webinar held earlier this year explains capabilities of this system (<https://www.youtube.com/watch?v=yeqYtIK-il4>).

Utility-associated fire risk mapping: I have developed techniques for mapping utility-associated fire risk (publications listed in my CV) and applied these techniques to map utility-associated fire risk over more than 500,000 square miles of service territory in the US and Canada on behalf of nine utilities. These techniques leverage numerical weather prediction, fire spread modeling, and high performance computing to generate high resolution maps of powerline fire risk that are then used internally for system hardening and proactive de-energization decisions.

Public Safety Power Shutoff consulting: I have established PSPS methodologies and criteria for three utilities in the Western US and am currently in the process of expanding to a fourth utility. I have also built real-time monitoring systems that automatically ingest weather forecast data, calculate fire weather indices,

perform fire behavior calculations, and display these outputs in dashboards for use by the utility clients in informing PSPS decisions.

Forensic fire investigations: I have applied fire ignition and spread modeling tools to conduct forensic fire reconstructions and ignition analyses for dozens of large-loss powerline fires in the US and Australia. I qualified as an Expert in both State and Federal Court on issues related to powerline fire ignition and spread and have provided expert testimony on these topics on multiple occasions at deposition and trial.

Thank you for your consideration. Should you have any questions, I can be reached at lautenberger@reaxengineering.com.

Sincerely,

A handwritten signature in blue ink that reads "Chris Lautenberger". The signature is written in a cursive, flowing style.

Christopher W. Lautenberger, PhD, PE

Enclosure: Curriculum Vitae

Chris Lautenberger, PhD, PE

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Professional Profile

Chris Lautenberger is a co-founder of Reax Engineering, a fire protection engineering and fire science firm with offices in Berkeley and Auburn, CA. He is a licensed Fire Protection Engineer with expertise in fire science, fire dynamics, fire modelling, and forensic fire reconstruction. Lautenberger's professional activities involve applying fire dynamics and combustion principles to analyze various aspects of fire and combustion processes, ranging from small-scale smoldering combustion to large-scale wildland fire dynamics. He has published on several aspects of combustion and fire, including flammability, pyrolysis, ignition, fire spread, and fire modeling. Lautenberger has over 20 years of experience applying fire dynamics calculations and fire models in support of scientific research, fire protection engineering design, and forensic fire reconstruction. Chris has developed computer models to analyze trajectories and ignition potential of metallic and woody particles generated by conductor clashing and interactions between vegetation and overhead electrical utilities, wildland fire propagation, and wildland fire risk. Lautenberger has provided expert testimony at deposition and trial on more than 25 occasions on litigation matters related to both wildland and structure fires, including several fires with losses in excess of \$100M. Dr. Lautenberger is an Instructor in the Department of Fire Protection Engineering at California Polytechnic State University, San Luis Obispo where he has co-taught Masters-level courses in Fire Dynamics and Fire Modeling.

Professional Licensure

Licensed Professional Engineer, State of California, # FP1676 (Fire Protection Engineering)

Education

PhD – Mechanical Engineering, University of California at Berkeley, January 2003 - December 2007

- Dissertation title: “A Generalized Pyrolysis Model for Combustible Solids”
- Major field: Combustion
- Minor fields: Wildland Fire Science and Fluid Dynamics

MS – Fire Protection Engineering, Worcester Polytechnic Institute, January 2000 - December 2001

- Thesis title: “CFD Simulation of Soot Formation and Flame Radiation”

BS – Mechanical Engineering, Worcester Polytechnic Institute, August 1995 - December 1999

Professional Experience

8/08 – present **Reax Engineering Inc.** Berkeley, CA and Auburn, CA *Founding Partner and Principal Engineer*

Representative projects:

- *California Public Utilities Commission (CPUC) High Fire Threat District Mapping:* Co-led (along with Pacific Gas & Electric and San Diego Gas & Electric) the Peer Development Panel tasked by the CPUC with developing high fire threat districts that identify areas where overhead electrical utilities present elevated or extreme risks of igniting damaging wildland or wildland urban interface fires. This map was adopted by the CPUC for regulatory purposes in 2018 and is currently used to promulgate regulations related to electrical utility fire safety in California.
- *Next Generation Open Source Wildfire Models for Grid Resiliency:* Currently leading the real-time wildfire spread and risk forecasting component of this \$5M project recently funded by the California Energy Commission. This project provides utilities and other stakeholders with real-time forecasts of active wildland fires as well as landscape-scale burn probabilities up to one week in the future. It also models ignition probability, fire size, and impacts from utility-caused

fires under forecasted wind and weather conditions to inform proactive de-energization decisions.

- *Utility-associated fire risk mapping*: Reax has mapped utility-associated fire risk over more than 500,000 square miles of service territory in the US and Canada on behalf of eight utilities. These techniques leverage numerical weather prediction, fire spread modeling, and high performance computing to generate high resolution maps of powerline fire risk that are then used internally for system hardening and proactive de-energization decisions.
- *Moonlight Fire (United States v. Sierra Pacific Industries et al.)*: Conducted NFPA 921 origin and cause hypothesis testing using fire science and fire modelling in the \$1B litigation surrounding the 2007 Moonlight Fire. Modeled initial fire spread and plume dynamics. Exposed a critical error in opposing expert's fire model that invalidated his opinions.
- *San Mateo Bridge Limousine Fire*: Analyzed ignition and spread of a limousine fire that killed five women as they traveled across the San Mateo Bridge. Modeled initial fire spread using Computational Fluid Dynamics (CFD) and small-scale materials flammability data to quantify available safe egress time and time to incapacitation.
- *Roseville Galleria Fire*: Analyzed ignition, initial spread, and effect of automatic sprinkler system failure on the outcome of the 2010 Roseville Galleria Fire that destroyed several stores, led to partial collapse of the roof and caused over \$50M in damage to a shopping mall in Northern California.
- *Modelling manufacturing of Ceramic Matrix Composites (CMCs)*. Working in conjunction with United Technologies and Pratt & Whitney in a project funded by the Air Force Research Laboratory, adapted Gpyro (a generalized pyrolysis for combustible solids) to model pyrolysis of ceramic matrix composites used in aircraft engines during manufacturing.

Selected wildland fire hazard analysis and modeling project work:

- Determined maximum reasonably foreseeable Santa Ana wind speed in Malibu Canyon using wind modeling and pole-mounted anemometers installed specifically for this project
- High resolution smoke plume modeling to assess potential for Libby Amphibole Asbestos (LAA) to be transported by large-scale wildland fires
- Developed de-energization criteria and associated weather monitoring analytics for utilities in California and Nevada
- Analyzed fire hazard/risk associated with major housing developments in San Diego County including Otay Ranch and Newland Sierra
- Developed ELMFIRE (Eulerian Level Set Model of Fire Spread), a parallelized model for simulating wildland fire spread and quantifying wildland fire risk via Monte Carlo simulation
- Conducted high resolution wind/weather modeling to analyze historical fire weather in Southern California
- Assisted utility clients with data requests and analytics associated with preparation of Senate Bill 209 Wildfire Mitigation Plans

Selected wildland fire forensic reconstructions and analyses:

- Reconstruction of initial spread of the 2011 Bastrop Complex Fire (Bastrop, TX)
- Analyzed ignition dynamics associated with the 2012 Sheep Fire near Lucille, ID
- Analysis of ignition, initial spread, and smoke transport from the 2009 Murrindindi Bushfire (Victoria, Australia)
- Simulation of smoke transport from the 2010 Crown Fire near Palmdale, CA
- Reconstruction of the spread of the 2008 Iron Complex Fire in Northern California and assessment of the impact of firing activities on timber loss in private inholdings
- Calculation of trajectory and temperature histories of metallic particles allegedly generated by clashing between aluminum and copper electrical conductors and analysis of grass-fire ignition potential, initial spread rate, and plume dynamics (Victoria, Australia)
- Analysis of wildland fires ignited by exhaust particles from a locomotive including analysis of particle trajectories and fuel ignitability (Victoria, Australia)

Selected structure and vehicle fire forensic reconstructions and analyses:

- Analysis of a methane generation, transport, and ignition from decomposing manure in a fatal pig barn fire
- Analysis of diesel fuel ignitability by hot surfaces in a fracking rig fire
- Reconstruction of fatal apartment fire where smoke alarms failed to activate (Long Beach, CA)
- Reconstruction of fatal fire in manufactured home including time to smoke alarm activation and analysis of available safe egress time (Castleberry, AL)
- Analysis of crude oil ignitability and time to incapacitation in a fatal fire where the cab of a truck was engulfed in flames from burning crude oil released during an accident.
- Analysis of ignitability of water/antifreeze mixture discharged from residential sprinkler system, analysis of initial fire spread, and assessment of burn injuries (Herriman, UT)
- Origin hypothesis testing for fatal alleged arson fire (Calcasieu Parish, Louisiana)
- Fire cause hypothesis testing and analysis of residential LPG explosion for alleged arson fire (Round Mountain, CA)
- Analysis of role of inoperable fire hydrant on manual fire suppression efforts and associated property damage during total loss fire in residential apartment building (Atlanta, GA)
- Reconstruction of fatal apartment fire: inter-apartment fire spread, time to smoke alarm activation, identification of contributory building code issues (Carrboro, NC)

Selected Fire Protection Engineering project work:

- Calculation of Light Rail Vehicle heat release rates in the San Francisco Central Subway using fire growth modeling and fire testing (San Francisco, CA)
- Analysis of rail vehicle design fires, testing, and modeling for Los Angeles County Metropolitan Transit Authority (Los Angeles, CA)
- Material property estimation for fire development modeling in new rail vehicle
- Development of automatic sprinkler protection criteria and analysis of flammable liquids processes at semiconductor plant (Santa Rosa, CA)
- Application of computer fire modeling and egress modeling to determine appropriate smoke exhaust rate for atrium at Marist College (Poughkeepsie, NY)
- Analysis of wildland urban interface fire and life safety concerns at proposed subdivisions in Oakland, CA, St. Helena, CA, and Encinitas, CA
- Sizing of atrium smoke exhaust rate in the new Student Union Building at San Jose State University (San Jose, CA)
- Development of a model for ignition of HEPA filters by embers at the Hanford nuclear waste treatment plant (Richland, WA)
- Modeling smoke and heat detector activation to develop a request for alternate means of protection at a large theater (Cincinnati, OH)
- Analysis of atrium smoke control system in residential highrise (Dallas, TX)

Selected thermal sciences & general project work:

- Heat transfer analysis and pyrolysis modeling for municipal solid waste to energy incineration technology
- Thermo-chemical analysis and heat transfer modeling of biomass torrefaction (low temperature pyrolysis) reactor
- Detailed Computational Fluid Dynamics (CFD) modeling of fluid flow and heat transfer in a rotary kiln biochar reactor
- CFD-based furnace modeling, heat transfer analysis, and pyrolysis modeling of proposed screw auger wood chip pyrolysis reactor
- Development of a comprehensive three-dimensional computational model for predicting heat release and emissions from charcoal combustion
- Flammability and thermal property assessment of new wall board product
- CFD modeling of blast wave from a bird bomb
- Thermodynamic analysis of non-traditional methods for carbon capture and sequestration
- Calculation of overhead electrical utility catenary curves and excursions in high winds
- Atmospheric dispersion modeling of pollutant transport using EPA's AERMOD software

- 12/10 – present **California Polytechnic State University, San Luis Obispo** *Instructor*
- Fire Protection Engineering Instructor in Cal Poly’s Masters degree program
 - Teaching responsibilities include FPE 502 Fire Dynamics and FPE 504 Fire Modeling
- 12/07 – 2/11 **University of California at Berkeley** *Post Doctoral Researcher*
- Conducted research on NSF Grant 0730556, “Tackling CFD Modeling of Flame Spread on Practical Solid Combustibles”
 - Assessed predictive capabilities of Fire Dynamics Simulator (FDS) for simulating flame spread and fire growth
 - Modified subroutines to improve predictive capabilities of FDS for flame spread modeling
 - Developed pyrolysis model and material property estimation techniques needed to simulate the pyrolysis of real-world solid fuels
 - Developed computer model for ignition of fuel beds by hot particles and fire brands to predict ignition of fuel beds and initiation of spot fires
- 1/02 – 6/08 **Arup Fire** San Francisco, CA *Fire Protection Engineer*
- Assisted clients with fire safety design and achieving code compliance or performance-based solutions for hospitals, casinos, malls, libraries, schools, museums, airports, and offices
 - Assessed fire performance of buildings using fire modeling and egress analyses in support of alternate methods of design
 - Developed and programmed a CFAST-based Monte-Carlo fire simulator
 - Simulated fire development in a rail vehicle and calibrated the model with large-scale experimental fire test data
 - Representative projects include Wynn Las Vegas, Hard Rock Hotel and Casino Las Vegas, Kaiser Permanente templates, New Los Angeles Federal Courthouse, San Mateo Public Library, California Academy of Sciences, Bay Area Rapid Transit (BART) Montgomery Street Station, and Seattle Public Library
- 10/00 – 12/01 **FM Global Research (formerly Factory Mutual Research Corporation)** Norwood, MA
- Examined existing soot formation and oxidation models in the literature and used this research to postulate a new engineering soot model that is compatible with FDS
 - Worked with FM Global and NIST scientists to add this new model for soot formation and oxidation to FDS, and performed simulations of laminar and turbulent diffusion flames
- 5/00 – 8/00 **Code Consultants, Inc.** Saint Louis, MO
- Responsible for examining proposed building designs for compliance with relevant codes
 - Performed engineering analyses to support equivalencies

Dissertation and Thesis

- 1/03 – 12/07 **PhD Dissertation** *University of California, Berkeley*
- Developed a generalized pyrolysis/material decomposition model (Gpyro) to simulate the gasification, pyrolysis, and combustion of condensed-phase fuels
 - Developed an optimization technique that uses a genetic algorithm to extract material pyrolysis properties needed for simulation of solid-phase pyrolysis from bench-scale fire tests
 - Performed FDS-based simulations of ignition, flame spread, and fire growth in normal and reduced gravity environments as part of a NASA-sponsored project
- 9/00 – 12/01 **MS Thesis** *Worcester Polytechnic Institute*
- Developed a model for soot formation/oxidation in non-premixed flames
 - Implemented model in FDS to calculate soot formation and flame radiation
- 8/98 – 5/99 **Major Qualifying Project (MQP)** *Worcester Polytechnic Institute*
- Developed an experimental program and ran several real-scale room/corner fire tests in WPI’s room calorimeter to evaluate the flame spread characteristics of composite wall linings

Peer Reviewed Publications

1. Lautenberger, C., de Ris, J., Dembsey, N.A., Barnett, J.R. & Baum, H.R., "A Simplified Model for Soot Formation and Oxidation in CFD Simulation of Non-premixed Hydrocarbon Flames," *Fire Safety Journal* **40**: 141-176 (2005).
2. Lautenberger, C., Zhou, Y.Y. & Fernandez-Pello, A.C., "Numerical Modeling of Convective Effects on Piloted Ignition of Composite Materials," *Combustion Science and Technology* **177**: 1231-1252 (2005).
3. Lautenberger, C. & Fernandez-Pello, A.C., "Approximate Analytical Solutions for the Transient Mass Loss Rate and Piloted Ignition Time of a Radiatively Heated Solid in the High Heat Flux Limit," *Fire Safety Science* **8**: 445-456 (2005).
4. Lautenberger, C., Rein, G. & Fernandez-Pello, A.C., "Application of a Genetic Algorithm to Estimate Material Properties for Fire Modeling from Bench-Scale Fire Test Data," *Fire Safety Journal* **41**: 204-214 (2006).
5. Rein, G., Lautenberger, C., Fernandez-Pello, A.C., Torero, J.L. & Urban, D.L., "Application of Genetic Algorithms and Thermogravimetry to Determine the Kinetics of Polyurethane Foam in Smoldering Combustion," *Combustion and Flame* **146**: 95-108 (2006).
6. Rich, D., Lautenberger, C., Torero, J.L., Quintiere, J.G. & Fernandez-Pello, C., "Mass Flux of Combustible Solids at Piloted Ignition," *Proceedings of the Combustion Institute* **31**: 2653-2660 (2007).
7. Kwon, J.-W., Dembsey, N.A., & Lautenberger, C.W., "Evaluation of FDS v4: Upward Flame Spread," *Fire Technology* **43**: 255-284 (2007).
8. Avila, M.B., Dembsey, N.A., Kim, M.E., Lautenberger, C., & Dore, C., "Fire Characteristics of Polyester FRP composites with Different Glass Contents," *Composites Research Journal* **2**: 1-14 (2008).
9. Lautenberger, C., Kim, E., Dembsey, N. & Fernandez-Pello, C., "The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite," *Fire Safety Science* **9**: 1201-1212 (2008).
10. Dodd, A.B., Lautenberger, C. & Fernandez-Pello, A.C., "Numerical Examination of Two-Dimensional Smolder Structure in Polyurethane Foam," *Proceedings of the Combustion Institute* **32**: 2497-2504 (2009).
11. Lautenberger, C. & Fernandez-Pello, A.C., "Generalized Pyrolysis Model for Combustible Solids," *Fire Safety Journal* **44**: 819-839 (2009).
12. Lautenberger, C. & Fernandez-Pello, A.C., "A Model for the Oxidative Pyrolysis of Wood," *Combustion and Flame* **156**: 1503-1513 (2009).
13. Hadden, R., Scott, S., Lautenberger, C., & Fernandez-Pello, A.C., "Ignition of Combustible Fuel Beds by Hot Particles: an Experimental and Theoretical Study," *Fire Technology* **47**: 341-355 (2011).
14. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Urban, D.L., & Ruff, G.A., "Mass Loss Rate at Ignition in Reduced Pressure Environments," *Combustion and Flame* **158**: 1301-1306 (2011).
15. Lautenberger, C. & Fernandez-Pello, C., "Optimization Algorithms for Material Pyrolysis Property Estimation," *Fire Safety Science* **10**: 751-764 (2011).
16. Dodd, A.B., Lautenberger, C., & Fernandez-Pello, A.C., "Computational Modeling of Smolder Combustion and Spontaneous Transition to Flaming," *Combustion and Flame* **159**: 448-461 (2012).
17. Matala, A., Lautenberger, C., & Hostikka, S., "Generalized direct method for pyrolysis kinetics parameter estimation and comparison to existing methods," *Journal of Fire Sciences* **30**: 339-356 (2012).
18. Fereres, S., Lautenberger, C., Fernandez-Pello, A.C., Urban, D.L., and Ruff, G.A., "Understanding ambient pressure effects on piloted ignition through numerical modeling," *Combustion and Flame* **159**: 3544-3553 (2012).
19. Wong, W., Alston, J., Lautenberger, C., and Dembsey, N., "CFD Flame Spread Model Validation: Multi-component Data Set Framework," *Journal of Fire Protection Engineering* **23**: 85-134 (2013).
20. Lautenberger, C., "Wildland Fire Modeling with an Eulerian Level Set Method and Automated Calibration," *Fire Safety Journal* **62**: 289-298 (2013).
21. Lautenberger, C., "Gpyro3D: A Three Dimensional Generalized Pyrolysis Model," *Fire Safety Science* **11**: 193-207 (2014).
22. Fernandez-Pello, A.C., Lautenberger, C., Rich, D., Zak, C., Urban, J., Hadden, R., Scott, S., and Fereres, S., "Spot fire ignition of natural fuel beds by hot metal particles, embers, and sparks," *Combustion Science and Technology* **187**: 269-295 (2015).
23. Yashwanth, B.L., Shotorban, B., Mahalingam, S., Lautenberger, C.W., and Weise, D.R., "A numerical investigation of the influence of radiation and moisture content on pyrolysis and ignition of a leaf-like fuel element," *Combustion and Flame* **163**: 301-316 (2016).
24. Lautenberger, C., "Mapping Areas at Elevated Risk of Large-Scale Structure Loss Using Monte Carlo Simulation and Wildland Fire Modeling," *Fire Safety Journal* **91**: 768-775 (2017).
25. Fawaz, M., Lautenberger, C., and Bond, T., "Prediction of organic aerosol precursor emission from the pyrolysis of thermally thick wood," *Fuel* (2020, in press).

Book Chapters

1. Lautenberger, C., Torero, J.L. & Fernandez-Pello, A.C., "Understanding Materials Flammability," in *Flammability Testing of Materials Used in Construction, Transport and Mining*, Edited by V. Apte, Woodhead Publishing, Cambridge, UK pp. 1-21, 2006.
2. Lautenberger, C. & Fernandez-Pello, A.C., "Pyrolysis Modeling, Thermal Decomposition, and Transport Processes in Combustible Solids," in *Transport Phenomena in Fires*, Edited by M. Faghri and B. Sunden, WIT Press, Billerica, MA pp. 209-248, 2008.
3. Lautenberger, C. & Fernandez-Pello, A.C., "Spotting Ignition of fuel beds by firebrands," in *Computational Methods and Experimental Measurements XIV*, Edited by C.A. Brebbia and G.M. Carlomango, WIT Press, Billerica, MA pp. 603-612, 2009.
4. Lautenberger, C. & Hostikka, S., "Large Scale Fire Modeling," in *Flame Retardancy of Polymeric Materials*, Second Edition, Edited by C.A. Wilkie and A.B. Morgan, Marcel Dekker pp. 551 – 585, 2010.
5. Lautenberger, C., Tien, C.L., Lee, K.Y., and Stretton, A.J., "Radiation Heat Transfer," in *SFPE Handbook of Fire Protection Engineering*, 5th Edition, Springer, pp. 102-137 (2016).
6. Lautenberger, C., "Pyrolysis," in *Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires*, Ed. Manzello, S.L., Springer, in press (2018).

Selected Conference Publications and Technical Reports

1. Beyler, C., Hunt, S., Lattimer, B., Iqbal, N., Lautenberger, C., Dembsey, N., Barnett, J., Janssens, M., & Dillon, S. "Prediction of ISO 9705 Room/Corner Test Results". United States Department of Transportation. United States Coast Guard Research and Development Center. Washington, DC. 1999.
2. Lautenberger, C., Stevanovic, A., Rich, D., & Torero, J., "Effect of Material Composition on Ignition Delay of Composites," *Composites 2003*, Anaheim CA, October 2003.
3. Lautenberger, C., Stevanovic, A., Rich, D., Torero, J. & Fernandez-Pello, A.C., "An Experimental and Theoretical Study on the Ignition Delay Time of Composite Materials," *Western States Section/The Combustion Institute*, Los Angeles CA, October 2003.
4. Rein, G., Lautenberger, C., Fernandez-Pello, A.C., Torero, J.L. & Urban, D.L., "Derivation of the Kinetics Parameters of Polyurethane Foam Using Genetic Algorithms," *Fourth Joint Meeting of the US Sections of the Combustion Institute*, Philadelphia PA, March 2005.
5. Rein, G., Lautenberger, C. & Fernandez-Pello, A.C., "On the Derivation of Polyurethane Kinetics Parameters Using Genetic Algorithms and its Application to Smoldering Combustion," *Fourth International Conference on Computational Heat and Mass Transfer*, Paris France, Vol. 1 pp. 578-584, May 2005.
6. Rein, G., Lautenberger, C. & Fernandez-Pello, A.C., "Using Genetic Algorithms to Derive the Parameters of Solid-Phase Combustion from Experiments," *20th International Colloquium on the Dynamics of Explosions and Reactive Systems*, Montreal, Canada, August 2005.
7. Rich, D., Lautenberger, C., McAllister, S. & Fernandez-Pello, A.C., "Microgravity Flame Spread Rates Over Samples of Polymer and Polymer/Glass Composites," *Western States Section/The Combustion Institute*, Boise ID, March 2006.
8. Coles, A., Wolski, A., Lautenberger, C.W., & Dembsey, N.A., "Building Code Requirements for Performance Based Designs and Fire Modeling", *Composites 2006*, St. Louis, MO, October 2006.
9. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Modeling the Effect of Environmental Variables on Opposed-Flow Flame Spread Rates with FDS," *International Congress on Fire Safety in Tall Buildings*, Santander, Spain, October 2006.
10. McAllister, S., Rich, D., Lautenberger, C., & Fernandez-Pello, C., "Modeling Microgravity and Normal Gravity Opposed Flame Spread over Polymer/Glass Composites," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-740.
11. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Effect of Environmental Variables on Flame Spread Rates in Microgravity," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-383.
12. Chatterjee, P., de Ris, J.L., & Lautenberger, C.W., "A General Combustion Model for Radiation Dominated Non-premixed Flames," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, 2007.
13. McAllister, S., Rich, D., Lautenberger, C., Fernandez-Pello, C. & Yuan, Z.G., "Modeling Microgravity and Normal Gravity Flame Spread Rates over Samples of Polymer and Polymer/Glass Composites," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.
14. Lautenberger, C. & Fernandez-Pello, C., "A Generalized Pyrolysis Model for Combustible Solids," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.

15. Coles, A., Wolski, A., & Lautenberger, C., "Using Fire Dynamics Simulator for Fire Growth Modeling," *Interflam 2007*, London, UK, September 2007.
16. Dembsey, N., Avila, M., Kim, E., Lautenberger, C., & Dore, C., "Fire Characteristics of Polyester FRP Composites with Different Glass Contents," *Composites & Polycon 2007* Tampa, FL, October 2007.
17. Lautenberger, C. & Fernandez-Pello, A.C., "Modeling Ignition of Combustible Fuel Beds by Embers and Heated Particles," *Forest Fires 2008*, 2008.
18. Coles, A., Lautenberger, C., Wolski, A., Smits, B., & Wong, K., "Using Computer Fire Modeling to Reproduce and Predict FRP Composite Fire Performance," *Composites & Polycon 2009*, 2009.
19. Kim, E., Dembsey, N., & Lautenberger, C., "Parameter Estimation for Pyrolysis Modeling Applied to Polyester FRP Composites with Different Glass Contents," *Fire and Materials 2009*, 2009.
20. Lautenberger, C., Wong, W., Dembsey, N., Coles, A., & Fernandez-Pello, C., "Large-Scale Turbulent Flame Spread Modeling with FDS5 on Charring and Noncharring Materials," *Fire and Materials 2009*, 2009.
21. Coles, A., Wolski, A., & Lautenberger, C., "Predicting Design Fires in Rail Vehicles," *13th International Symposium on Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT 13)*, 2009.
22. Dodd, A.B., Lautenberger, C., & Fernandez-Pello, A.C. "Numerical Modeling of Smoldering Combustion and Transition to Flaming," *Sixth US National Combustion Meeting*, University of Michigan, Ann Arbor, MI, 2009.
23. Scott, S, Hadden, R., Fereres, S., Lautenberger, C., & Fernandez-Pello, A.C., "Ignition of Combustible Fuel Beds by Embers and Heated Particles," *Western States Section/The Combustion Institute*, Irvine, CA, October 2009.
24. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Urban, D., & Ruff, G., "Effect of Ambient Pressure on Mass Loss Rate at Piloted Ignition," *Western States Section/The Combustion Institute*, Boulder, CO, March 2010.
25. Lautenberger, C., Rich, D., Kramer, M., Fernandez-Pello, C., and Stephens, S., "Communication Infrastructure Provider Assets in the Wildland Setting: CIP Fire Threat Map," June 9, 2010.
26. Lautenberger, C., Wong, W.C., Coles, A., Dembsey, N., & Fernandez-Pello, C., "Comprehensive Data Set for Validation of Fire Growth Models: Experiments and Modeling," *Interflam 2010*, Nottingham, UK, July 2010.
27. Thiry, A., Suzanne, M., Bellivier, A., Bazin, H., Coppalle, A., & Lautenberger, C., "Different Approaches for Fire Source Modeling – Application to Arcueil Experiments," *Interflam 2010*, Nottingham, UK, July 2010.
28. Dodd, A., Lautenberger, C., Fernandez-Pello, C., & Putzeys, O., "Examination of the Spontaneous Transition from Smoldering to Flaming: Comparison of Simulations and Experiments," *Interflam 2010*, Nottingham, UK, July 2010.
29. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Ruff, G., & Urban, D., "Modeling the effect of ambient variables on piloted ignition of solid combustible materials," *Seventh US National Combustion Meeting*, March 2011.
30. Matala, A., Lautenberger, C., & Hostikka, S., "Direct method for estimation of pyrolysis kinetics and comparison to existing methods," *Seventh US National Combustion Meeting*, March 2011.
31. Lautenberger, C., "Modeling Wildland Fire Spread Using an Eulerian Level Set Method and High Resolution Numerical Weather Prediction," *International Congress on Fire Computer Modeling*, October 2012, Santander, Spain.
32. Lautenberger, C., Sexton, S., & Rich, D., "Understanding Long Term Low Temperature Ignition of Wood," *International Symposium on Fire Investigation Science and Technology*, College Park, MD, September 22-24, 2014, p. 361.
33. Zicherman, J., Lautenberger, C., & Wolski, A., "Challenges in Establishing Design Fires for Passenger Rail Vehicles," *Proceedings of Fire and Materials 2015*, Interscience Communications, February 2-4 2015, San Francisco, CA, pp. 749 – 764.

Short Courses

1. *Lawrence Livermore National Laboratories Fire Modeling Short Course – A Short Course Presented to Fire Protection Engineers*. Co-taught, with Professor James Milke (University of Maryland) and Professor Frederick Mowrer (California Polytechnic State University), a 3-day short course on fire dynamics and fire modeling for Lawrence Livermore and Lawrence Berkeley National Laboratories employees (March 20 – 22, 2012).
2. *First Asia-Pacific Combustion Institute Summer School – Fundamental Combustion Problems in Fire*. Co-taught sessions related to fire science and pyrolysis modelling in Valparaiso, Chile (November 11 – 15, 2019).

Selected Presentations and Invited Lectures

1. "A Practical CFD Model for Soot Formation and Flame Radiation," *International Conference on Engineered Fire Protection Design*, San Francisco, CA, June 13, 2001.
2. "Effect of Material Composition on Ignition Delay of Composites," *Composites 2003 Convention and Trade Show*, Anaheim, CA, October 2, 2003.
3. "Experimental and Theoretical Study on Ignition Delay of Composites," *Western States Section of the Combustion Institute Fall 2003 Meeting*, Los Angeles, CA, October 20, 2003.
4. "Approximate Analytical Solutions for the Transient Mass Loss Rate and Piloted Ignition Time of a Radiatively Heated Solid in the High Heat Flux Limit," *The Eighth International Symposium on Fire Safety Science*, Beijing, China, September 20, 2005.
5. "Effect of Environmental Variables on Flame Spread Rates in Microgravity," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 8, 2007.
6. "Generalized Pyrolysis Model for Combustible Solids," *2007 Annual Fire Conference*, National Institute of Standards and Technology, Gaithersburg, MD, April 4, 2007.
7. "Generalized Pyrolysis Model for Combustible Solids," *5th International Seminar on Fire and Explosions Hazards*, Edinburgh, UK, April 24, 2007.
8. "Generalized Pyrolysis Model for Combustible Solids," FM Global Research, Norwood, MA, June 19, 2007 (invited seminar).
9. "Pyrolysis Modeling – What Level of Accuracy is Needed to Match Current Gas-Phase Accuracy?," *The Ninth International Symposium on Fire Safety Science*, Fire Spread Modeling Workshop, Karlsruhe, Germany, September 21, 2008 (invited presentation).
10. "Estimating Material Properties for Numerical Pyrolysis Modeling from Laboratory Experiments," *The Ninth International Symposium on Fire Safety Science*, Karlsruhe, Germany, September 21, 2008 (invited presentation).
11. "The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite," *The Ninth International Symposium on Fire Safety Science*, Karlsruhe, Germany, September 26, 2008.
12. "Fire Growth Modeling in Buildings – Where We Are and Where We Need to Be," IIE Seminar, University of Edinburgh, Edinburgh, UK, October 30, 2008 (invited seminar).
13. "Some Unsolved Problems in Fire Dynamics: The Needed Physics and Mathematics," *Mathematical Problems in Fire Safety Engineering Joint Workshop*, Edinburgh, UK, October 31, 2008 (invited seminar).
14. "Large-Scale Turbulent Flame Spread Modeling with FDS5 on Charring and Noncharring Materials," *Fire and Materials 2009*, San Francisco, CA, January 26, 2009.
15. "Fire Growth Modeling: Small-Scale Flammability Tests to Large Scale Fire Behavior," *ASTM E5 Research Review*, Vancouver, BC, June 15, 2009 (invited presentation).
16. "Optimization Algorithms for Material Pyrolysis Property Estimation," *The Tenth International Symposium on Fire Safety Science*, College Park, MD, June 21, 2011.
17. "The Role of Fire Science, Fire Dynamics, and Fire Modeling in Testing Forensic Fire Investigation Hypotheses," IIE Seminar, University of Edinburgh, Edinburgh, UK, August 20, 2012 (invited seminar).
18. "Modeling Wildland Fire Spread Using an Eulerian Level Set Method and High Resolution Numerical Weather Prediction," *International Congress on Fire Computer Modeling*, October 19, 2012, Santander, Spain.
19. "Gpyro3D: A Three Dimensional Generalized Pyrolysis Model," *The Eleventh International Symposium on Fire Safety Science*, Christchurch, New Zealand, February 10, 2014.
20. "Understanding Long Term Low Temperature Ignition of Wood," *International Symposium on Fire Investigation Science and Technology*, College Park, MD, September 22, 2014.
21. "Current Status of Applied Fire Dynamics Simulations," 2015 Northern California/Nevada SFPE Fire Protection Engineering Seminar, San Ramon, CA, April 8, 2015 (invited seminar).
22. "Identifying Areas with Elevated Risk of Large-Scale Structure Loss from Wildland Fires," *The 12th International Symposium on Fire Safety Science*, Lund, Sweden, June 14, 2017.
23. "Wildfire Modeling and Risk of Potential Structure Loss," *2018 Annual Society of Fire Protection Engineers Greater Atlanta Chapter Fire Safety Conference*, Duluth, GA, March 14, 2018.
24. "Wildfire Modeling and Risk of Potential Structure Loss," 2018 Northern California / Nevada Society of Fire Protection Engineers Seminar, San Ramon, CA, March 28, 2018.
25. "Smoke Alarm Failures: Owner/Landlord Responsibility," 2018 Inner Circle of Investigators Seminar, Newport Beach, CA, October 4, 2018.
26. "California's 2017 Wildfires: What Happened? And Can we Map Areas Where it Could Happen Again?," 2018 Society of Fire Protection Engineers Annual Conference & Expo, Nashville, TN, October 29, 2018.

27. “Applications and Limitations of Current-generation 2D Wildfire Models,” National Institute of Standards and Technology (NIST) Large Outdoor Fire Modelling Workshop, Gaithersburg, MD, March 18, 2019.
28. “Automated Real-time Ensemble Fire Forecasting in California,” 6th International Wildland Fire Behavior and Fuels Conference, Albuquerque, NM, May 1, 2019.
29. “California’s October 2017 Wildfires: What Happened, and Can We Map Areas Where It Could Happen Again?,” Society of Fire Protection Engineers Webinar Series, May 13, 2019.
30. Applications and Limitations of Current-generation 2D Wildfire Spread Models in the Utility Sector,” California Utility Forecasters Meeting, Irwindale, CA, June 25, 2019.
31. “Mapping Wildland Fire Risk in the Western US Using Fire Modeling and Monte Carlo Simulation,” FM Global Research Forum, Norwood, MA, June 28, 2019.
32. “Automated Real-time Ensemble Fire Forecasting in the Continental US,” National Academies Workshop: Modeling and Simulation of Fires, Berkeley, CA, October 7, 2019.
33. “Automated Real-Time Fire Forecasting in California: A Mid-season Assessment,” 2019 Society of Fire Protection Engineers Annual Conference & Expo, Phoenix, AZ, October 15, 2019.
34. “Emerging Technologies for Detecting, Mapping, and Forecasting the Spread of Wildfires,” 2019 National Wildfire Litigation Conference, Bastrop, TX, October 20, 2019.
35. “Overview of Wildland Fire Science and Basic Methods for Modeling Spread,” Environmental Governance and Climate Resilience course, Stanford University, January 21, 2020.
36. “Automated Real-Time Fire Spread and Risk Forecasting,” Northwest Hydroelectric Association 2020 Annual Conference, Seattle, WA, February 19, 2020.

Publication and Presentation Awards

- Best Paper Overall at *Composites & Polycon 2007*, Tampa, FL, October 2007 for Dembsey, N. *et al.*, “Fire Characteristics of Polyester FRP Composites with Different Glass Contents,” presented by N. Dembsey.
- Best paper (second prize) at the *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007 for Lautenberger, C. & Fernandez-Pello, C., “Generalized Pyrolysis Model for Simulating Charring, Intumescent, Smoldering, and Noncharring Gasification,” presented by C. Lautenberger.
- 2011 International Association for Fire Safety Science Best Thesis Award (Americas Region) for 2007 PhD Dissertation entitled “Generalized Pyrolysis Model for Combustible Solids”. This IAFSS award recognizes the best research dissertation at the PhD and Masters levels in the field of fire safety science and engineering that was completed between 2007 and 2010.
- International Association for Fire Safety Science Best Paper Award (honorable mention) for 2008 paper entitled “The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite,” by Lautenberger, C., Kim, E., Dembsey, N. & Fernandez-Pello, C. [*Fire Safety Science* **9**: 1201-1212 (2008)].
- 2014 Society of Fire Protection Engineer’s Jack Bono Award for the paper from Volume 23 of the *Journal of Fire Protection Engineering* that has most contributed to the advancement and application of professional Fire Protection Engineering for the paper entitled “CFD Flame Spread Model Validation: Multi-component Data Set Framework,” by Wong, W., Alston, J., Lautenberger, C., and Dembsey, N., [*Journal of Fire Protection Engineering* **23**: 85-134 (2013)].
- 2017 Philip Thomas Medal of Excellence. This is awarded to the author(s) of the best paper presented at the previous International Association for Fire Safety Science (IAFSS) Symposium. It is based on five criteria that are used to identify the best paper: pertinence, utility, significance, rationality, and eloquence.

Conference/Journal Advisory Boards/Technical Committees

- Associate Editor of *Fire Technology*, 2014 - present
- Member of Scientific Advisory Board for *International Congress on Combustion and Fire Dynamics*, Santander, Spain, October 2010
- Member of Technical Program Committee (Compartment Fires) for the *Tenth International Symposium on Fire Safety Science* (IAFSS Symposium), College Park, MD, June 2011
- Member of Scientific Advisory Board for *International Congress on Fire Computer Modeling*, Santander, Spain, October 2012

Journal Referee / Peer Review

- *Advances in Engineering Software*
- *Advances in Materials Science and Engineering*
- *Applied Thermal Engineering*
- *Artificial Intelligence Review*
- *Asia-Oceania Symposium on Fire Science and Technology*
- *Brazilian Journal of Chemical Engineering*
- *Chemical Engineering Science*
- *Combustion and Flame*
- *Combustion Science and Technology*
- *Construction and Building Materials*
- *Earth and Space Science*
- *Ecological Modeling*
- *Energy & Fuels*
- *Engineering Science and Technology*
- *Experimental Thermal and Fluid Science*
- *Express Polymer Letters*
- *Fire and Materials*
- *Fire Safety Journal*
- *Fire Safety Science (IAFSS Symposia)*
- *Fire Technology*
- *Frontiers Mechanical Engineering*
- *Fuel Processing Technology*
- *Industrial & Engineering Chemistry Research*
- *International Colloquium on the Dynamics of Explosions and Reactive Systems*
- *International Journal of Computational Fluid Dynamics*
- *International Journal of Heat and Mass Transfer*
- *International Journal of Thermal Sciences*
- *International Journal of Wildland Fire*
- *Journal of Advances in Modeling Earth Systems*
- *Journal of Computational Science*
- *Journal of Fire Protection Engineering*
- *Journal of Fire Sciences*
- *Proceedings of the Combustion Institute*
- *Science of the Total Environment*
- *Thermochimica Acta*