

Exponent®
Engineering & Scientific Consulting

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Professional Profile

Nicholas Faenza, Ph.D., P.E., CFEI, CVFI, is a principal engineer in the Materials Science and Electrochemistry practice at Exponent. With specialized experience in battery safety consulting, he assists clients in lithium-ion battery failure analysis, battery fire investigations, EV and BESS safety assessments, and product recall support across automotive, consumer electronics, medical devices, and grid storage applications.

Dr. Faenza applies his technical expertise in batteries and energy storage technologies to lead failure analysis investigations, support design evaluations, and resolve complex technical issues involving battery safety and performance for multiple industries. His work helps clients determine root causes of failure, evaluate design and manufacturing concerns, and develop corrective actions in risk- and time-sensitive matters.

Dr. Faenza's experience includes leading fire investigations in battery energy storage systems (BESS), electric vehicles, and data centers, as well as helping clients navigate product recalls. He provides regulatory and litigation support for product liability matters and consults as an expert in high-consequence commercial disputes.

Dr. Faenza's experience also includes extensive lithium-ion battery abuse testing, safety assessments, and product design consulting for electric vehicles, BESS, consumer electronics, and robotics applications. He has designed and lead hundreds of custom thermal, mechanical, and electrical test programs to characterize failure modes, quantify safety margins, and evaluate battery cell and pack-level response under nominal and fault conditions. He has demonstrated expertise in testing and evaluating lithium-ion batteries and battery systems to mitigate thermal runaway initiation, limit fire propagation, and evaluate the effectiveness of hazard reduction strategies.

By integrating rigorous experimental testing with failure analysis insights and engineering risk assessments, he supports clients in identifying design vulnerabilities, refining safety features, and providing a technical foundation for product development decisions for complex battery-powered systems. Based in Phoenix, Arizona, he supports clients throughout the U.S., while providing local presence and rapid engagement across Arizona and the Southwest.

Battery Design and Safety Consulting

Dr. Faenza advises clients on battery system design, safety, reliability, and compliance across electric vehicles, grid energy storage systems, consumer electronics, robotics, and other technology platforms. He directs multidisciplinary programs to evaluate design vulnerabilities, safety hazards, and failure modes; leads test programs for critical safety features; and develops engineering assessments that help clients improve design robustness, mitigate hazards, and align products with applicable standards,

regulations, and industry practices. Dr. Faenza is a recognized technical expert in battery abuse testing, thermal runaway propagation mitigation, and battery safety, with publications and presentations addressing forced thermal runaway testing, fire spread and suppression, and strategies for designing safer battery systems.

Lithium-Ion Battery Failure Analysis

Dr. Faenza has investigated hundreds of lithium-ion battery failures and has identified failure mechanisms across cells, packs, and battery systems in support of internal and expert witness matters. He applies advanced analytical techniques and experienced engineering judgment to evaluate root cause, defect allegations, and safety performance in product development, product liability, and regulatory disputes for a range of industries. Drawing on his materials science background, Dr. Faenza leads multidisciplinary investigations into related material, component, and product failures across complex engineered systems.

Battery Recall and Regulatory Support

Dr. Faenza has led high-consequence investigations into product recalls involving batteries and electrical systems in automotive vehicles, consumer electronics, and medical devices. His work enables his clients to rapidly identify concerns, mitigate risks, manage recalls, and implement corrective actions. Dr. Faenza helps clients improve future product performance and safety, prepare for litigation, and respond effectively to regulatory agencies, including the National Highway Traffic Safety Administration (NHTSA), the Consumer Product Safety Commission (CPSC), and the Food and Drug Administration (FDA), as well as state regulators.

Electric Vehicle and Battery Energy Storage System Fire Investigations

Dr. Faenza is a certified fire and vehicle fire investigator with specialized expertise in lithium-ion battery, electric vehicle, and battery energy storage system fire investigations. He has led numerous investigations involving utility-scale energy storage systems, data centers, transit vehicles, commercial vehicles, light-duty vehicles, micromobility products, and off-highway equipment. His work includes fire origin-and-cause assessment, evidence preservation, telemetry and system data analysis, analytical failure analysis, and evaluation of design, manufacturing, operational, and environmental contributors.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Rutgers University, 2018

B.S., Materials Science and Engineering, University of Maryland, College Park, 2013

Journal of the Electrochemical Society Editor's Choice Article, 2017

Department of Materials Science & Engineering Outstanding Materials Student Service Award, 2013

Licenses and Certifications

Professional Engineer Metallurgical, Arizona, #81093

Professional Engineer Metallurgical, California, #2011

Certified Fire and Explosion Investigator (CFEI)

Certified Vehicle Fire Investigator (CVFI)

Prior Experience

Before joining Exponent, Dr. Faenza's graduate research focused on investigating the structural and chemical degradation mechanisms for positive electrode materials at high states of charge. He also led a thorough analysis of the surface impurity species that develop on state-of-the-art electrode materials and their impact on the material's electrochemical performance. During this time, he developed material fabrication experience grounded in hydrothermal co-precipitation synthesis that encompasses the use of a variety of thermal and powder processing techniques. Dr. Faenza is experienced with numerous analytical techniques, including X-ray computed tomography (CT), X-ray diffraction (XRD), microcalorimetry, thermogravimetric analysis (TGA), Fourier-transform infrared spectroscopy (FTIR), and others.

Before graduate school, Dr. Faenza developed graphene and silicon-based electrodes and also worked on reducing the flammability of polyurethane foam at the National Institute of Standards and Technology (NIST).

Professional Affiliations

National Association of Fire Investigators

The Electrochemical Society

Publications

Notable Publications

D. Torelli, N. Faenza, P. Johns, S. Lawton, and J. Frake, Evaluation of Fire Spread and Suppression Techniques in Micro-Mobility Battery Packs, ECS Advances, (2024)

N. Faenza, R. Spray, M. Kuykendal, Understanding the Fundamental Mechanisms of Battery Thermal Runaway Propagation and Mitigation, SAE Technical Paper 2023-01-1515, (2023)

N. Faenza, N. Pereira, D.M. Halat, J. Vinckeviciute, L. Bruce, M. Radin, P. Mukherjee, F. Badway, A. Halajko, F. Cosandey, C. P. Grey, A. Van der Ven, and G. G. Amatucci, The Phase Evolution and Degradation Modes of $R\bar{3}m$ LixNi1-y-zCoyAlzO2 Electrodes Cycled Near Complete Delithiation, Chemistry of Materials, (2018).

(Editors' Choice) N. Faenza, Lejandro Bruce, Zachary W. Lebens-Higgins, Irene Plitz, Nathalie Pereira, Louis F. J. Piper, and Glenn G. Amatucci, Growth of Ambient Induced Surface Impurity Species on Layered Positive Electrode Materials and Impact on Electrochemical Performance, Journal of the Electrochemical Society, 164 (2017) A3727-A3741.

(Invited) N. Faenza, Z. Lebens-Higgins, P. Mukerjee, S. Sallis, N. Pereira, F. Badway, A. Halajko, G. Ceder, F. Cosandey, L. Piper, and G. G. Amattuci, Electrolyte-Induced Surface Transformation and Transition-Metal Dissolution of Fully Delithiated LiNi0.8Co0.15Al0.05O2, Langmuir 33 (2017) 9333-9353.

Additional Publications

M. Wolfman, B. May, V. Goel, S. Du, Y-S. Yu, N. Faenza, N. Pereira, K. Wiaderek, R. Xu, J. Wang, G. G. Amatucci, K. Thornton, J. Cabana, Origin of Rapid Delithiation In Secondary Particles of LiNi0.8Co0.15Al0.05O2 and LiNiyMnzCo1-y-zO2 Cathodes, ChemRxiv¸ (2023).

P. Mukherjee, P. Lu, N. Faenza, N. Pereira, G. G. Amatucci, G. Ceder, F. Cosandey, Atomic Structure of Surface-Densified Phases in Ni-rich Layered Compounds, ACS Applied Materials & Interfaces, 13, (2021), pg. 17478-17486.

M. Wolfman, Y-S Yu, B. May, Z. Lebens-Higgins, S. Sallis, N. Faenza, N. Pereira, N. Shirato, V. Rose, D. Shapiro, G. G. Amatucci, L. F. J. Piper, and J. Cabana, Mapping Competitive Reduction upon Charging in LiNi0.8Co0.15Al0/05O2 Primary Particles, Chemistry of Materials, 14, (2020), pg. 6161-6175.

Z. Lebens-Higgins, H. Chung, M. Zuba, J. Rana, Y. Li, N. Faenza, N. Pereira, B. D. McCloskey, F. Rodolakis, W. Yang, S. Whittingham, G.G. Amatucci, Y. S. Meng, T. Lee, and L.F.J Piper, How Bulk Sensitive is Hard X-ray Photoelectron Spectroscopy: Accounting for the Cathode-Electrolyte Interface When Addressing Oxygen Redox, J. Phys. Chem. Letters., 11, (2020), pg. 2106-2112.

Z. Lebens-Higgins, D. Halat, N. Faenza, M. Wahila, M. Mascheck, T. Wiell, S. Eriksson, P. Palmgresun, J. Rodriguez, F. Badway, N. Pereira, G. G. Amatucci, T. Lee, C. Grey, L. F. J. Piper, Surface Chemistry Dependence on Aluminum Doping in Ni-rich LiNi0.8Co0.2-yAlyO2 Cathodes, Nature Scientific Reports, (2019).

Z. Lebens-Higgins, N. Faenza, M. Radin, H. Liu, S. Sallis, J. Rana, J. Vinckeviciute, P. Reeves, M. Zuba, F. Badway, N. Pereira, K. Chapman, T-L. Lee, T. Wu, C.P. Grey, B. Melot, A. Van der Ven, G. G. Amatucci, W. Yang, and L. F. J. Piper, Revisiting the charge compensation mechanisms in LiNi0.8Co0.2-yAlyO2 systems, Materials Horizons, (2019).

Z. Lebens-Higgins, J. Vinckeviciute, J. Wu, N. Faenza, Y. Li, S. Sallis, N. Pereira, Y. Shirley Meng, G.G. Amatucci, A. Van der Ven, W. Yang, L. F. J. Piper, Distinction Between Intrinsic and X-ray Induced Oxidized Oxygen States in Li-Rich 3d Layered Oxides and LiAlO2, The Journal of Physical Chemistry C, (2019).

J. Vinckeviciute, M. Radin, N. Faenza, G.G. Amatucci, and A. Van der Ven, Fundamental insights about interlayer cation migration in Li-ion electrodes at high states of charge, Journal of Materials Chemistry A, (2019).

P. Mukherjee, N. Faenza, N. Pereira, J. Ciston, L. Piper, G. G. Amatucci, and F. Cosandey, Surface Structural and Chemical Evolution of Layered LiNi0.8Co0.15Al0.05O2 (NCA) Under High Voltage and Elevated Temperature Conditions, Chemistry of Materials, 30, pg. 8431-8445, (2018).

P. Mukherjee, N. Faenza, N. Pereira, G. G. Amatucci, and F. Cosandey, Equivalence of Three Seemingly Different Phases of Ni-rich Li-ion Battery Cathodes - New Insights Using Combined STEM and EELS Study, Microscopy and Microanalysis, 24, pg. 1502-1503 (2018).

Z. Lebens-Higgins, S. Sallis, N. Faenza, F. Badway, N. Pereira, D. Halat, M. Wahila, C. Schlueter, T-L. Lee, W. Yang, C. Grey, G. Amatucci, and L. Piper, Evolution of the Electrode-Electrolyte Interface of LiNi0.8Co0.15Al0.05O2 Electrodes Due to Electrochemical and Thermal Stress, Chemistry of Materials, 30 pg. 958-969 (2018).

Z. W. Lebens-Higgins, N. V. Faenza, P. Mukherjee, S. Sallis, F. Badway, N. Pereira, C. Schlueter, T.-L. Lee, F. Cosandey, G. G. Amatucci, and L. F. J. Piper, Electrochemical and Thermal Stress of LiNi0.8Co0.15Al0.05O2 Electrodes: Evolution of Aluminum Surface Environments, ECS Transactions, 80 (10) pg. 197-206 (2017).

S. Sallis, N. Pereira, P. Mukherjee, N.F. Quackenbush, N. Faenza, C. Schuleter, T. Lee, W. L Yang, F. Cosandey, G. G. Amatucci, L. Piper, Surface degradation of Li1-xNi0.8Co0.15Al0.05O2 cathodes: Correlating charge transfer impedance with surface phase transformations, Applied Physics Letters, 108 (2016).

J. Wan, A. Kaplan, J. Zheng, X. Han, Y. Chen, N. Weadock, N. Faenza, S. Lacey, T. Li, J. Guo, and L. Hu, Two dimensional silicon nanowalls for lithium ion batteries, Journal of Materials Chemistry A, 17 (2014).

Presentations

N. Faenza, Understanding the Fundamental Mechanisms of Battery Thermal Runaway Propagation and Mitigation, NASA-SAE Energy & Mobility Conference, Cleveland, OH, September 15, 2023.

N. Faenza, Multifaceted Approach to Battery System Safety, National Academy of Engineers, Frontiers of Engineering Symposium, Bled, Slovenia, October 2022.

N. Faenza, Safety Considerations For Advanced Cathode Materials, Cathode Summit, May 25, 2022.

N. Faenza, K. Beers, T. Bogart, J. Harding, How Do You Choose A Battery Manufacturer For Your Device? Part 1: Cell Qualification, Exponent Live Webinar, February 18, 2021.

N. Faenza, L. Bruce, Z. W. Lebens-Higgins, I. Plitz, N. Pereira, L. F. J. Piper and G. G. Amatucci, Surface Impurities on Layered Positive Electrode Materials: Mechanism for Formation and Impact on Performance, Laboratory for Surface Modification/Institute for Advanced Materials, Devices and Nanotechnology Symposium, New Brunswick, NJ, USA, February 27, 2018.

N. Faenza, P. Mukherjee, S. Sallis, N. Pereira, H. Das, G. Ceder, L. Piper, F. Cosandey, and G. G. Amatucci, Dynamic Transformations of Layered Compounds at Full Delithiation Due to Surface Triggered Reactions, Electrochemical Society PRIME Conference, Honolulu, HI, USA, October 6, 2016.

N. Faenza, Y. Li, and R. Davis, Multi-Substrate Flammability Reduction Using a Layer-by-Layer Assembly with Natural Materials, National Institute of Standards and Technology SURF Symposium, Gaithersburg, MD, USA, August 2013.

N. Faenza, Y. Li, Y. Kim, and R. Davis, Reduced Flammability of Polyurethane Foam Using a Layer-by-Layer Assembly with Natural Materials, National Institute of Standards and Technology SURF Symposium, Gaithersburg, MD, USA, August 2012.

N. Faenza, L. Bruce, Z. W. Lebens-Higgins, I. Plitz, N. Pereira, L. F. J. Piper, and G. G. Amatucci, Surface Impurities on Layered Positive Electrode Materials-Mechanisms for Formation and Impact on Performance, Materials Research Society Fall Conference, Boston, MA, US, November 2017.

N. Faenza, Z. Lebens-Higgins, P. Mukherjee, S. Sallis, F. Badway, A. Halajko, N. Pereira, G. Ceder, F. Cosandey, L. Piper, and G. G. Amatucci, NECEES: Electrochemically Initiated Surface Chemistries Inhibiting the Realization of the Theoretical Capacity of LiNi0.8Co0.15Al0.05O2, Department of Energy, Energy Frontier Research Center, Midterm Review, July 2017.

N. Faenza, S. Sallis, P. Mukherjee, H. Das, A. Urban, N. Pereira, L. Piper, F. Cosandey, G. Ceder and G. G. Amatucci, Understanding Cathode-Electrolyte Reactions via Microcalorimetry, NorthEast Center for Chemical Energy Storage Summer Meeting, June 29, 2016.

N. Faenza and G. G. Amatucci, Understanding Cathode-Electrolyte Reactions via Microcalorimetry, NorthEast Center for Chemical Energy Storage Fall Meeting, October 2015.

Project Experience

Battery Design and Safety Consulting

Dr. Faenza assesses design vulnerabilities and safety hazards in battery-powered systems across EVs, grid storage, consumer electronics, and robotics, advising clients on hazard mitigation, design robustness, and the application of standards and regulations to improve safety, reliability, performance, and compliance. Examples of this work include:

- **Electric Bus Battery Design Review —** Analyzed high-voltage battery packs for transit and commercial applications to identify potential safety, reliability, and performance concerns. Evaluated design and performance documentation, assessed construction quality through a physical teardown of the battery packs, and performed analytical analysis of select sub-components.

- **EV Battery Manufacturing and Compliance Support —** Advised multiple EV manufacturers in improving their battery pack testing, manufacturing, and integration processes to reduce hazards and increase quality efficiently. Analyzed process documentation relative to applicable standards, literature, industry practice, and engineering judgment. Conducted on-site inspections and employee interviews to identify areas for development and improvement.

- **Energy Storage System Design Support —** Evaluated and tested numerous energy storage system designs for fire protection, thermal runaway propagation mitigation, and other battery safety considerations relative to UL 9540A, NFPA 855, and other applicable regulatory frameworks. Assessed the systems' design through document analysis, physical inspection, and customized forced thermal runaway abuse testing.

- **Battery Cell Abuse Testing —** Designed and executed hundreds of customized forced thermal runaway abuse experiments on batteries of different chemistries and formats to assess the cells' response and considerations for integrating into a battery pack. Developed customized testing and analysis methods to replicate failure modes and field conditions, improve test fidelity, and support client needs for automotive, energy storage, consumer electronics, and robotics applications.

- **EV Battery Abuse and Development —** Led multiple electric vehicle battery abuse testing programs, particularly including thermal runaway propagation mitigation testing and non-standard abuse testing. Advised EV and electric vehicle takeoff and landing (EVTOL) manufacturers on battery pack design to develop safer and more reliable high-voltage battery systems.

- **Vehicle Parking Structure Fire Hazard Assessment —** Investigated potential hazards resulting from a vehicle fire in an enclosed parking structure and evaluated fire detection and suppression systems. Performed a design assessment of the parking structure and assessed the potential hazards resulting from a vehicle thermal event, including evaluating the differences in the fire hazards between electric and combustion engine vehicles.

- **Robotics Battery Pack Development —** Advised multiple robotics and drone manufacturers on battery compliance, safety, and reliability based on design assessments and experimental results. Evaluated the battery packs' design and performance documentation, including layout, component specifications, and standardized testing results. Designed and executed standard and customized abuse testing to evaluate the battery systems' response and potential hazards.

- **Wearable Electronics Battery Thermal Runaway Hazard Assessments —** Assessed potential thermal, chemical, and electrical hazards from wearable electronics devices during a battery

thermal runaway event. Performed burn injury assessments to different user body parts based on forced failure experimental results. Evaluated the devices' design and consulted on potential improvements to mitigate and eliminate hazards.

- **Battery Electrolyte Induced Electronics Failures —** Investigated and advised on failure mechanisms by degradation of electronics from exposure to lithium-ion battery electrolyte. Developed a failure analysis investigation methodology to assess the severity and nature of circuit board degradation from electrolyte exposure. Evaluated printed circuit board and device designs for susceptibility to an electrolyte exposure induced failure mechanism.

Lithium-Ion Battery Failure Analysis

Dr. Faenza has investigated hundreds of lithium-ion battery failures, ranging from material to system-level failures. He is experienced in assessing the root cause of failure in support of internal and expert investigations. Examples of this work include:

- **Heavy-Duty Truck EV Batteries —** Investigated the cause of thermal runaway failures in high-voltage lithium-ion batteries for heavy-duty electric trucks. Evaluated failure analysis results, reviewed battery pack design documentation, and forced failure re-creation test results to assess the efficacy of manufacturing quality control improvements and battery pack design changes.

- **Electric Utility Cart Battery —** Investigated the cause and origin of a fire involving the battery pack of an electric utility cart. Performed a failure analysis investigation into the battery pack and battery management system electronics to identify the origin of failure and assess manufacturing quality and design concerns.

- **E-Bike Batteries —** Investigated the cause of multiple failures in e-bike battery packs resulting from battery cell concerns, electrical faults, and environmental ingress issues. Analyzed incident and exemplar units using a variety of non-destructive and destructive analytical techniques to identify damage patterns, potential failure modes, and product hazards.

- **GPS and Telematics Fleet Tracker —** Performed multiple failure analysis investigations different GPS and telematics fleet tracking devices that used lithium thionyl chloride batteries. Analyzed the cause of thermal failures in field devices, performed re-creation testing on exemplar units, and evaluated the design and manufacturing quality differences between different battery cell vendors to identify safety hazards.

- **E-Cigarette Battery Fires —** Investigated the cause of numerous fires in lithium-ion batteries used for electronic cigarettes that caused burn injuries and property damage. Evaluated product liability claims involving design defects and alleged safety issues with the battery cells, the devices' electronics controls, and the battery chargers.

- **Bluetooth Hearing Buds —** Examined the cause of lithium-ion battery thermal failures in Bluetooth hearing buds. Performed a failure analysis investigation, assessed the battery cell construction and design quality, and conducted re-creation testing on hypothesized failure

modes, including overdischarge and recharge. Results were used to guide recall and product design change decisions.

- **Bluetooth Speakers —** Investigated the cause of thermal fires in portable Bluetooth speakers, including incidents related to lithium-ion battery thermal runaway and electrical faults. Performed analytical analysis of incident and exemplar devices, reviewed design documentation and executed forced fault re-creation testing to assess the cause of failure.

- **Portable Therapeutic Massage Gun —** Evaluated the cause of a fire initiated by a battery-powered therapeutic massage gun. Analyzed the incident device using non-destructive analytical techniques, such as X-ray Computed Tomography (CT), and performed a destructive inspection to identify damage patterns and failure modes.

- **Portable Battery Bank —** Performed a fire origin-and-cause investigation of a portable battery bank that caught fire while charging. Examined the incident device and exemplar units with similar usage history to evaluate the cause of the fire.

- **Virtual Reality Controllers —** Investigated battery failures in hand-held virtual reality controllers resulting from electrical faults induced by leakage of electrolyte from the battery cell and subsequent exposure to the device's electronics. Evaluated the failure mechanism and fault severity through customized forced fault re-creation testing and analysis of tested units.

- **Thermal Runaway Propagation Barriers —** Evaluated the efficacy and robustness of different thermal runaway propagation barrier materials during battery thermal failures. Analyzed the material characteristics and thermal properties of the barrier materials using established analytical techniques and custom battery thermal runaway re-creation tests.

Battery Recall and Regulatory Support

Dr. Faenza has led complex investigations into product recalls involving batteries and electrical systems in automotive vehicles, consumer electronics, and medical devices. Dr. Faenza's work has been presented to regulators such as NHTSA, the CPSC, and FDA. Examples of this work include:

- **Electric Vehicle Recalls —** Principal investigator with multiple automotive manufacturers to identify the cause of dozens of fires in electric vehicles, including for commercial, transit, and off-highway applications. Applied forensic investigation results, statistical analysis of vehicle data, and testing of exemplar units to develop risk assessments and support corrective actions including hardware and software recalls.

- **Smartphone Recalls —** Investigated the cause of fires and thermal events in battery packs of multiple smartphones models. Led multidisciplinary teams to evaluate the root cause of the thermal events and assess potential safety hazards to consumers and property. Conducted thorough analyses of the battery packs' construction, manufacturing quality, and degradation pathways to determine projected failure rates, develop a hazard assessment, and propose

potential mitigation strategies. The investigation results were presented to the CPSC and resulted in either a software update or hardware recall.

- **Smartwatch and Fitness Tracker Recalls —** Investigated the cause of fires and thermal events in multiple smartwatches, fitness trackers, and wearable electronics. Analyzed alleged field failures for external abuse or misuse, design defects, manufacturing concerns, and other potential causes of failure. Performed extensive customer complaint reviews, forced fault re-creation testing, and analytical assessments of exemplar and field returned units to assess potential hazards and degradation modes during use. Evaluated the burn injury potential of the wearable devices during thermal runaway events. Results were presented to the CPSC and resulted in a recall of select models.

- **Wearable AI Assistant Recall —** Investigated failures of wearable AI assistance devices related to fires involving their lithium-ion batteries. Performed and analyzed analytical test results on exemplar and field returned units and assessed device production and design information to evaluate the root cause for failures and potential hazards to consumers. Results were presented to the CPSC and resulted in a recall.

- **Medical Diagnostic Monitoring Device Failure Investigation —** Analyzed the design and quality of a battery-powered diagnostic monitoring device and investigated the causes of alleged battery thermal runaway and electrical failures. Evaluated the battery pack and product design to relevant safety standards and performed custom forced failure re-creation testing. Results from the design review and abuse testing were communicated to FDA.

EV and BESS Fire Investigations

Dr. Faenza is an experienced and certified fire investigator who leads lithium-ion battery, EV, and BESS fire investigations across utility storage, data centers, and automotive applications, including transit, commercial, light-duty, and off-highway vehicles. Examples of this work include:

- **Transit Bus Propulsion Battery Fires —** Investigated the root cause and origin of multiple battery fires for electric busses across different transit authorities and failure conditions. Performed extensive failure analysis testing and analytical characterization to evaluate the battery pack design, battery management system, and the battery cell quality. Worked with the client and suppliers to identify multiple causes of failure, including manufacturing faults and accelerated degradation of the lithium-ion battery cells, which resulted in a voluntary recall by the vehicle manufacturer.

- **Electrified Construction Vehicle Fires —** Principal investigator for multiple lithium-ion battery fires in electric construction and off-highway vehicles. Performed on-site fire investigations, supported evidence preservation, and led analytical analysis to identify a manufacturing defect in

the lithium-ion battery pack as the cause of the fires, which resulted in a voluntary recall by the vehicle manufacturer.

- **Commercial Delivery Vehicle Fires —** Led numerous fire investigations in both electric and internal combustion engine delivery vehicles. Specific experience includes investigating incidents that occurred during charging, driving, storage, and crash scenarios, as well as multi-vehicle fires and delayed reignition scenarios.

- **Electric Bike Warehouse Fires —** Investigated commercial building fires caused by lithium-ion battery packs for electric bicycle and micromobility applications. Analyzed evidence to determine the cause of failure and assisted the client in developing mitigation strategies to prevent future incidents.

- **California Building-Based BESS Fires —** Performed numerous cause-and-origin investigations into building-based lithium-ion BESS systems throughout California, including GWh-scale installations. Analyzed digital information (e.g., system telemetry, fire alarm and suppression system logs, video, etc.) and performed forensic examinations and analytical testing of evidence.

- **Arizona Building-Based BESS Fire —** Investigated the root cause and origin of a fire involving a building-based battery energy storage system using lithium-ion batteries in Arizona. Evaluated telemetry and fire alarm control panel data and analyzed evidence to assess the likely cause and contributing factors of the incident.

- **Arizona Container BESS Fire —** Principal investigator for a container-format lithium-ion BESS fire for utility storage that occurred in Arizona. Performed an on-site fire investigation, analyzed system telemetry data and design, and supported root-cause determination and resolution.

- **Nuclear Power Plant Universal Power Supply Battery Incident —** Investigated the cause of severe electrical failures of lead-acid batteries for back-up power in a nuclear power plant. Worked with a multidisciplinary team to perform metallurgical examinations of the battery terminals, assess applied internal and external stresses, and evaluate potential degradation modes.

- **Data Center BESS Fire —** Principal investigator for a lead-acid battery fire that occurred in the energy storage system for a data center. Performed an on-site investigation, collected and analyzed evidence, assessed telemetry data, and supported root-cause determination.