



Exponent®
Engineering & Scientific Consulting

Robert Kennedy, Ph.D.

Senior Associate | Thermal Sciences

Houston

+1-832-325-5753 | kennedyr@exponent.com

Professional Profile

Robert Kennedy, PhD, EIT, is a Thermal Sciences consultant at Exponent with five years of experience evaluating battery energy storage systems (BESS), fire safety systems, and thermal-fluid systems. Dr. Kennedy helps designers, manufacturers, system integrators, and legal teams to address challenging problems in aerospace, defense, industrial, consumer products, and energy sectors.

Dr. Kennedy led several projects involving BESS, thermal control systems, and fires prior to entering consulting. He applies engineering fundamentals, including heat transfer, fluid mechanics, and thermodynamics to analyze real-world hardware from the piece-part to the full system. Furthermore, he utilizes his product development background to identify the root causes of failures, such as design and manufacturing defects. Based on the technical facts of the case, he develops conclusions and clearly communicates his findings to the larger team.

Battery Energy Storage Systems (BESS)

During his graduate program, Dr. Kennedy characterized catastrophic Lithium-Ion (Li-Ion) thermal runaway in cell arrays, including heat and gas release, propagation rate, and mitigations. His research has been used to better understand the challenges surrounding Li-Ion BESS and subsequently size safety mitigation systems. Since then, he has developed BESS for aerospace applications that are mass and volume optimized while simultaneously being passively propagation resistant (PPR) to single cell thermal runaway failures. He has also developed containment enclosures for both bulk battery storage and BESS capable of mitigating the intense heat and effluent release from thermal runaway. In all cases, Dr. Kennedy has been directly involved in the modeling and analysis efforts, and designing and running the subsequent destructive fire tests to verify mitigation performance, reliability, and above all else, safety.

Fire Safety Systems

In tandem with his research on Li-ion battery fires, Dr. Kennedy's graduate program also included combustion, fires, explosions, and associated experimental and modeling techniques. He leverages this knowledge to develop fire-resistant designs for preventing incidents, detection systems for alerting personnel to fires, thermal injury prevention mechanisms, and suppression systems, including portable and automatic fire extinguishing systems.

Thermal and Fluid Systems

Dr. Kennedy's uses the engineering fundamentals of heat transfer, fluid mechanics, and thermodynamics to analyze thermal and fluid systems across a range of applications. He has designed and developed

mass and volume optimized hardware for human spaceflight, including heat sinks, cold plates, heat exchangers, evaporative cooling systems, radiators, multi-layer insulation, safe touch temperature surfaces, and ice prevention systems for gaseous propellant flow. In addition to modeling and analysis, he is also well versed in building out testbeds and conducting test campaigns for evaluating thermal-fluid system performance, reliability, and operating ranges. While much of his experience has targeted aerospace applications, the knowledge and skills he has crafted are directly extensible to high power challenges, including data center cooling, electric vehicle powertrains (in tandem with the EV battery), and other industrial process equipment.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, University of Texas - Austin, 2021

B.S., Mechanical Engineering, University of Texas - Austin, 2017

Prior Experience

Principal Investigator, Paragon Space Development Corporation, Houston, 2024-2026

Staff Thermal Engineer, Axiom Space, Houston, 2021-2024

Graduate Research Assistant, The University of Texas, Austin, 2017-2021

Finishing and Compounding Technologist Intern, ExxonMobil, Houston, 2016

Production Test Engineer Intern, SpaceX, McGregor, 2015

Career Exploration Program (CEP) Intern, Universities Space Research Association (USRA), Houston, 2012-2013

Professional Affiliations

American Society of Mechanical Engineers (ASME) – Member

National Fire Protection Association (NFPA) – Member

National Association of Fire Investigators (NAFI) – Member

Publications

Kennedy R, Ezekoye OA. [Characterization of thermal propagation rates between adjacent lithium-ion pouch cells: effects of thermal barriers](#). In International Heat Transfer Conference Digital Library. Begel House Inc. 2023.

Kennedy RW, Ezekoye OA. [Experimental and modeling characterization of nickel–manganese–cobalt \(532\) lithium ion battery arrays with thermal separators](#). Journal of Energy Storage 2023; 60:106682.

Kennedy RW, Bilyaz S, Ezekoye OA. [Low-order modeling of Lithium Cobalt Oxide Lithium ion battery arrays with various states of charge](#). Journal of Energy Storage 2022; 49:104053.

Kennedy RW. [Experimental and computational characterization of thermal runaway propagation in lithium-ion pouch cell arrays](#). The University of Texas at Austin 2021.

Kennedy RW, Marr KC, Ezekoye OA. [Gas release rates and properties from lithium cobalt oxide lithium ion battery arrays](#). Journal of Power Sources 2021; 487:229388.

Archibald E, Kennedy R, Marr K, Jeevarajan J, Ezekoye OA. [Characterization of thermally induced runaway in pouch cells for propagation: characterization of thermally induced runaway](#). Fire technology 2020; 56(6):2467–2490.

Presentations

Kennedy RW, Joyce CJ, Hazlewood A, Bower C. [Adapting ionomer-membrane humidity control technologies for spacecraft evaporative cooling](#). Oral Presentation, 54th International Conference on Environmental Systems (ICES), Prague, Czech Republic, 2025.

Kennedy RW, Archibald E, Baird AR, Marr KC, Ezekoye OA. Quantifying vent gas production in lithium-ion batteries. Oral Presentation, Society of Fire Protection Engineers (SFPE) Premium Series Webinar, Online, 2020.

Kennedy RW, Archibald E, Baird AR, Marr KC, Ezekoye OA. Quantifying vent gas production in lithium-ion batteries. Oral Presentation, 19th Society of Fire Protection Engineers (SFPE) Annual Conference & Expo, Phoenix, Arizona, 2019.

Project Experience

Battery Energy Storage Systems (BESS)

- Developed shipboard cabinet/rack scale, BESS containment system for supporting nominal operations and mitigating thermal runaway events, including passively preventing shelf-to-shelf propagation and propagation beyond cabinet of origin, ducting and evacuating effluents away from cabinet/room, and increasing system energy storage density by ~10x that of baseline standard from UL 9540 and NFPA 855.
- Developed passive propagation resistant (PPR) system for aerospace flight BESS thermal runaway mitigation, including cell-to-cell heat transfer mitigation, effluent ducting and evacuation, particulate and foreign-object-debris (FOD) isolation and evacuation, cell side-wall rupture prevention, cell electrical shorting prevention, and cell inspection program.
- Developed portable battery containment system for mitigating thermal runaway events from battery modules capable of preventing module-to-module propagation, detecting events and alerting personnel, and preventing fire/failure propagation outside the system.
- Designed and analyzed thermal control system (TCS) for BESS, including both 1D excel and Thermal Desktop thermal modeling, material selection, redundancy and quality assurance assessments, and determining temperature sensor placements for operation and test campaigns.

Fire Safety Systems

- Developed and analyzed water-based agent fire extinguisher for rapid fireball extinguishment (<1s) within combat ground vehicle to replace legacy HFC-227 systems, including flow modeling for rapid release, liquid-gas mixing analysis to achieve droplet size distribution, and test data analysis to verify rate of release, droplet size distribution, and release cone angle.
- Developed and analyzed carbon-dioxide (CO₂) space-rated fire extinguisher for human spaceflight, including hardware and material selection, orifice sizing for desired flow rate, and tank design/selection for zero-G environment.

- Analyzed fine water mist (FWM) space-rated fire extinguisher for human spaceflight, including droplet size distribution, tank design/selection for zero-G environment, and extension to other applications.
- Evaluated options for space-rated fire detection systems, including conventional, aviation, and limited heritage spacecraft smoke detectors, along with thermal-based fire detectors.

Thermal-Fluid Systems

- Evaluated and tested space-rated evaporative cooler system for next generation spacesuit, back-up/emergency cooling systems, and other radiation-limited applications with test results showing 3-4x better performance than existing state of the art.
- Designed and analyzed mini-channel cold plates for high-power electronics, including coupled, 1D heat and flow analysis to select channel geometry, materials, and flow rates, and optimization for mass, volume, and power constraints.
- Analyzed space-rated thermal control system, using Thermal Desktop to size plumbing, radiators, and flow rates through system, as well as ensuring redundancy and reliability through design.
- Evaluated hardware failure contingencies, including failure modes analyses and redundancy, hardware replacement, and associated human factors.