UL Research Institutes focuses on rigorous independent research into ongoing and emerging human safety risks. As threats evolve and their consequences become more severe, UL Research Institutes pursues scientific discovery to advance public safety — marshaling resources to scan for, assess, and mitigate emerging and ongoing human safety risks across multiple societal and technological sectors.

UL Standards & Engagement pursues its longstanding role as a critical facilitator of standards-related public-private partnerships around the world. UL Standards & Engagement translates data and safety science research into actionable, rigorous safety standards and drives safety advocacy campaigns focused on improving public safety.

UL Solutions is committed to partnering with customers and stakeholders around the world to help solve safety, security, and sustainability challenges. A global safety science leader, UL Solutions delivers testing, inspection, and certification services, together with software products and advisory offerings, that support customers’ product innovation and business growth.
Our areas of research focus and expertise

**Chemical Insights Research Institute**
Promoting human health through research and awareness of the potential risks of chemical pollutants.

**Digital Intelligence Safety Research Institute**
Developing new frameworks for machine learning, artificial intelligence, and decision-making technologies.

**Electrochemical Safety Research Institute**
Investigating the limits of electrochemical technologies to drive safer innovations and product performance.

**Fire Safety Research Institute**
Dedicated to addressing the world’s unresolved fire safety risks and emerging dangers.

**Material Discovery Research Institute**
Studies new materials and applications, including ways we might harness new materials to advance sustainability, safety, and health.
Current Research Projects

**Firefighter Safety & Effectiveness**
- Residential Size-up and Search & Rescue
- Near Miss Investigations (ESS, Residential and Commercial Fires)
- Coordinated Fire Attack (Single Family, Garden Apartments & Strip Malls)
- Training Fires Best Practices
- PPE Heat Transfer
- Training Fire Exposures from the Source
- Fire Dynamics Bootcamps

**Cardiovascular & Chemical Exposure Risks in Today’s Fire Service**
- Fireground
- Training Ground
- PPE Cleaning
- PPE Interfaces
Current Research Projects

**Fire Dynamics**
- Smoke Explosion / Backdraft
- Residential Energy Storage Systems
- Numerical Modeling of Ventilation-Induced Flashover (IFSC)

**Fire Investigation Research**
- Post Fire Exposure to Investigators
- Impact of HVAC on Fire Patterns
- Thermal Decomposition of Materials
- Materials Database

**Wildland Urban Interface**
- Fire Brand Ignition of Building Materials (IFSC)
- Water Run-off
- Structure to Structure Heat Transfer
Upcoming Research Projects

• Research Applications for the Fire Service
• Fire Safety of Batteries and Electric Vehicles
• Fire Dynamics and Fire Control in Multi-Story Residential Structures
• Fire Patterns based on Oxygen Availability
• Fire Model Development and Validation
• Addressing Fire in Global Informal Settlements
• WUI Smoke Exposure
• WUI Building Construction
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Technological Advancements Push the Boundaries of All Hazards and the Fire Service Emergency Response System

2022 UFF Position Statement
Changes to your workplace

Automatic Storage and Retrieval Systems (ASRS) and Expansive Warehouses

Energy Storage Systems (Commercial and Residential)

Electric Vehicles (Especially in Garages)

E-bikes and Scooters (Micro-Mobility Devices)
Will there be failures?
Lithium-Ion Batteries

Types of flaming hazards:

1. **Rapid HRR increase** – unprecedented fire growth rate compared to ordinary combustibles.

2. **Flame Jetting** – strong plume. Risk of igniting adjacent combustibles/batteries.

3. **Cell/material ejection** - additional ignition sources.

4. **Stranded energy & reignitions** – thermal runaways, fire, explosion hazards occurring hours/days after initial event.
Flaming – Rapid HRR increase
Flaming (3) – Cell/material ejection
Explosion: (uncontained deflagration)

UL-IAFF-DOE Experiment Series: Residential ESS Hazards to First Responders (June-July 2022)
Yesterday, at a bomb range in Western IL...
The fire service sees the results of systematic failures every single day.
• The fire service work environment continues to evolve based on the actions and needs of society.

• It is incredibly difficult for fire chiefs and officers to remain ahead of all these changes and to be proactive with codes and standards enforcement.

• Metro Fire Departments often lack the personnel and funding resources to address their core all-hazards community risk reduction and response mission, much less keep up with the accelerating pace of complex technological and societal evolution.

• Often, it appears that a disproportionate amount of risk and the risk management burden is being placed on local fire departments/agencies without sufficient resources to successfully prepare and respond when an incident occurs.

• This preparedness and operational deployment capability burden should be appreciated, reinforced, and properly resourced by the AHJ.
• AHJs should develop and regularly update full-scale community risk assessments, including documenting high-risk and extremely high-risk locations.

• AHJs should recognize and document locations and operational hours of storage facility locations including large warehouses, packaging and mailing facilities, and energy storage facilities.

• Fire chiefs should document the lack of, or inappropriate/insufficient resources and/or capabilities to handle an emergency incident at high-/extreme-risk locations.

• Fire chiefs should identify resource constraints and “speak truth to power” so local decision makers understand that:
  o Fire protection and risk reduction is a “whole community” activity and cannot be left solely to the fire service
  o Building owners/operators have the primary responsibility to properly protect their assets and occupants, especially when deploying high-risk systems
  o AHJs cannot assume that their local fire service is prepared to respond to incidents involving emerging technologies
  o Even the best-resourced fire departments can be challenged by the complexity of incidents involving high-risk systems

• Free training offered by a private entity is not free. Even if the materials are free, the time to train the firefighters is not. There are budgetary costs to firefighters being out of service for training events or overtime pay for call-back training events.
Discussion

• Would it be beneficial for private entities to invest in developing training and preplan exercises for local fire departments in their jurisdiction?

• What should be the threshold for accountability when these private hazards create life safety or exposure hazards for responders?

• What is a reasonable staffing and deployment model to take on these new hazards?

• What is the source of funding for local fire department training? What is the priority for training for extreme high hazard response and mitigation?

• Has the fire service been involved in any community planning when high-risk structures or high-risk environments are created in local communities?

• If it is just a property protection incident, should firefighters operate in a defensive mode to protect exposures? What other hazards does that present to our communities?