Battery Safety Science Symposium

August 11, 2021

Advancing safer energy storage through science

Electrochemical Safety Research Institute
Underwriters Laboratories Inc.

UNDERWRITERS LABORATORIES®

Electrochemical Safety Research Institute – Programs & Initiatives

Battery Safety Summits

Battery Safety Science Webinar Series/Symposium

Produce educational materials in collaboration with UL NFP Education and Anti-Counterfeiting teams

Battery Safety Council

Conference presentations, webinars and journal and book publications

Electrochemical Safety Research Institute

University & Industry collaborations for research & other initiatives (US & India)

Standards Committees (internal and external)

Battery Safety Council Meetings

Exchange of technical information on battery safety.

- The **Battery Safety Council** (BSC) is an *ad hoc* group organized by a group of government and industry staff dedicated to the exchange of technical information on battery safety.
- BSC meetings were initiated in 2015.
- Outcome of the Boeing 787 investigation – NASA/UL/NTSB were all part of the investigation and provided support through a Non-Advocate Review board, public hearings and testing.
- Held 9 BSC forums.
- 2021 BSC meeting in Q4 (virtual or in-person).

BSC November 2019 Forum

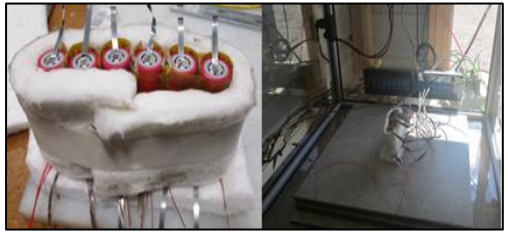
Battery Safety Summits

Industry focused summit on battery safety.

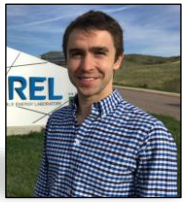
- Another outcome of the Boeing 787 investigation.
- First Summit was held in the U.S. (DC area).
- The following summits were held in China (2015), India (2016), Canada (2016), Korea (2017), Japan (2018).
- In 2019, the Summit was held in Singapore and this was changed to address “Aviation” with a major focus on battery safety.
- In 2019, a Energy Storage Summit was held in India to address EV and ESS sectors.
- The Summits cover a range of topics that are relevant to the country that it is held in. For instance, it covered areas from cell manufacturing to disposal and recycling in countries like China, Korea and Japan. Whereas in India, it focused on battery safety specifically in the Automotive and Stationary Grid Storage sectors.

Research Collaborations

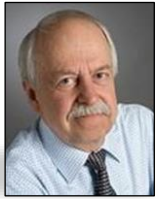
Fundamental studies to understand safety issues and hazards in batteries.



Collaborator	Research Projects
Purdue University	• Fast charge safety for Li-ion batteries • Lithium-ion internal short safety study
Case Western Reserve University	• Fire and smoke characterization of Li-ion cells with modeling studies • Lithium-ion safe electrolyte project
UC San Diego	• Research collaborator and member of the Innovative Materials Discovery and Design Institute (IMDD) – Recycling and lithium-metal research studies
NASA Johnson Space Center	• Project on mitigation of thermal runaway using different materials • Destructive analysis and elemental and material analysis (components of a cell) • Safety of micro-USB Li-ion batteries
Stress Engineering Services	• Continue Thermal Runaway Propagation on Li-ion cell packages (for G27 and UN IWG) • Flow battery safety research
UL Inc. Fire Research Team	• Fire research in Li-ion Batteries



Dr. Donal Finegan
NREL



Dr. Fredrik Larsson & **Dr. Bengt-Erik Mellander**
Chalmers University of Technology

Dr. Shirley Meng
UCSD

Dr. Daniel Abraham
Argonne National Lab

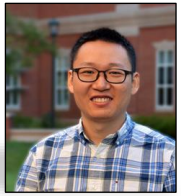
Laurie Florence
UL Inc.

Dr. Linda Gaines
Argonne National Laboratory

Robert Swaim
Principal, HowItBroke.com

Dr. Palani Balaya
N.U. Singapore

Dr. Steve Kerber & **Dr. Mark McKinnon**
Underwriters Laboratories Inc., FSRI



Dr. Jun Xu
University of North Carolina at Charlotte

Dr. Pierre L'Eplattenier & **Iñaki Çaldichoury**
ANSYS

Battery Safety Science Symposium - Agenda

SESSION	SESSION TITLE	TIME (CDT)	NAME	AFFILIATION	DESIGNATION
Opening	Remarks	08:30 a.m. – 08:40 a.m.	Dr. Christopher Cramer	Underwriters Laboratories Inc.	Senior Vice President and Chief Research Officer
	Introduction to the Symposium	08:40 a.m. – 08:50 a.m.	Dr. Judy Jeevarajan	Underwriters Laboratories Inc.	Research Director - Electrochemical Safety
I	*Recent Advances: Safety Perspective*	08:50 a.m. – 09:15 a.m.	Dr. Joshua Lamb	Sandia National Laboratories	Principal Member of the Technical Staff, Advanced Power Sources R&D
		09:15 a.m. – 09:40 a.m.	Dr. Rachel Carter	US Naval Research Laboratory	Mechanical Engineer, Alternative Energy Section
		09:40 a.m. – 10:05 a.m.	Dr. Sagar Mitra	Indian Institute of Technology Bombay	Professor, Energy Science and Engineering Department
		10:05 a.m. – 10:30 a.m.	Dr. Partha P. Mukherjee	Purdue University	Professor & University Faculty Scholar School of Mechanical Engineering
II	*Novel Electrode Materials: The Future*	10:30 a.m. – 11:00 a.m.	Dr. Arumugam Manthiram	The University of Texas at Austin	Professor, McKetta Department of Chemical Engineering
		11:00 a.m. – 11:30 a.m.	Dr. Sarbajit Banerjee	Texas A&M University	Professor, Department of Materials Science & Engineering
Lunch Break		11:30 a.m. – 12:00 p.m.			

Agenda

Keynote Address	*Lithium Batteries: Future Trends and the Energy/Safety Trade-off*	12:00 p.m. – 01:00 p.m.	Dr. Stanley Whittingham	Binghamton University State University of New York	Professor, Department of Chemistry 2019 Nobel Prize in Chemistry
III	*Empirical and Modeling Studies: New Insights*	01:00 p.m. – 01:25 p.m.	Dr. Venkat Viswanathan	Carnegie Mellon University	Associate Professor, Department of Mechanical Engineering
		01:25 p.m. – 01:50 p.m.	Dr. Ankur Jain	The University of Texas at Arlington	Associate Professor, Department of Mechanical and Aerospace Engineering
		01:50 p.m. – 02:15 p.m.	Yulong Liu and Dr. Jeff Dahn - Presented by Dr. Jeff Dahn, FRSC, O.C.	Dalhousie University	Professor of Physics and Atmospheric Science; NSERC/Tesla Canada Inc. Industrial Research Chair
		02:15 p.m. – 02:40 p.m.	Dr. Gleb Yushin	Georgia Tech	Professor, School of Materials Science and Engineering; Co-Founder, Sila Nanotechnologies, Inc.
		02:40 p.m. – 03:05 p.m.	Dr. Rana Mohtadi	Toyota Research Institute of North America	Principal Scientist, Materials Research for Energy Storage
IV	*What's New in Standards and Regulations*	03:05 p.m. – 03:25 p.m.	Mr. George A. Kerchner	PRBA - The Rechargeable Battery Association	Executive Director
		03:25 p.m. – 03:40 p.m.	Mr. Howard D. Hopper	UL	Global Regulatory Services Manager
		03:40 p.m. – 03:55 p.m.	Mr. Brian O'Connor P.E.	National Fire Protection Association	Technical Services Engineer
		03:55 p.m. – 04:10 p.m.	Mr. Manjunath Vittala Rao	Underwriters Laboratories Inc.	Standards & Programs Manager, South Asia & Sub-Saharan Africa
Closing	Concluding Remarks	04:10 p.m. – 04:20 p.m.	Dr. Christopher Cramer	Underwriters Laboratories Inc.	Senior Vice President and Chief Research Officer
	Closing Remarks and Acknowledgements	04:20 p.m.	Dr. Judy Jeevarajan	Underwriters Laboratories Inc.	Research Director - Electrochemical Safety

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Thank you

Learn more about our electrochemical safety science research and initiatives at:

Web: https://ul.org/what-we-do/electrochemical-safety
Email: NFP.ElectrochemicalSafety@ul.org