FINAL

Commission to Advance Lithium-Ion Battery Safety in Maryland Mtg (HB468-Ch 950)

Thursday, February 6, 2025 · 10:00am – 1:00pm

In Person: MFRI 4500 Campus Dr, College Park, MD 20740 – Classroom 1

Virtual: Google Meet joining info

Video call link: https://meet.google.com/oef-ddjt-nua

Or dial: (US) +1 929-256-1376 PIN: 627 692 014#

More phone numbers: https://tel.meet/oef-ddjt-nua?pin=6980108590044

The meeting was called to order by Commission Chairman Emil Nusbaum at 10:08 a.m.

Commission members were marked virtually present as no in person meeting was held due to inclement weather as follows: Chairman Emil Nusbaum, Marc Boolish, Vincent Baker, Michael Cox, DeAndre Wilson, Kitty McIlroy, Justin Short, Taiwo Alo, David Black, Haley Kotzker, Christopher Neidhart, Chris Pilzer, Nicholas Rodricks, Garrett Fitzgerald, Ginny Rogers Geoffrey Donahue, Ivan Browning and Tessa Sanchez. Absent Commission Members: Robert Whittlesey. Members of the public were in attendance. Staff in attendance: Ken Bush, MSP; Penny Doty, MSP; and Jacquetta Bushrod, MSP. Presenters: Brian Engle, Director; Business Development, Amphenol; President, NAATBatt International; Chair, SAE Battery Standards Steering Committee; Chair, SAE Fir Responders Task Force, and Commission Member Marc Boolish, Director, PRBA – Rechargeable Battery Association.

Roll call was completed by the Commission staff. Staff confirmed there was a majority present.

Chairman Nusbaum motioned to have Tessa Sanchez, Tesla, replace the recently vacated Commission Member spot which was represented by a professional from the vehicle propulsion battery manufacturer industry. The vacated spot was the result of employment termination and severed communication with the Commission exhibited from the previously appointed Commission Member. The motion was seconded by member Chirs Pilzer and with no objections raised by the remaining Commission members. The newly elected Commission member Tessa Sanchez will be added to the Commission Roster and the Consumer and Transportation Applications Subcommittee Roster to replace the vacancy.

Chairman Nusbaum reviewed the meeting agenda and the minutes from the last meeting held on Decembe 5, 2024. The minutes as presented were approved by all the attending Commission members for finalization with no objections raised.

Chairman Nusbaum introduced Brian Engle, Director; Business Development, Amphenol; President, NAATBatt International; Chair, SAE Battery Standards Steering Committee; Chair, SAE Fir Responders Task Force. Brian Engle provided the Commission with a presentation titled “Learning from Events – the Evolving State of EV and Battery Safety Regulations, Standards and Practice“. The Presentation included the following topics”.

!. Learning from Events – the Evolving State of EV and Battery Safety Regulations.

A. Prevention, detection and suppression of lithium-ion battery fires in consumer transportation and utility applications (with review and consideration of NFPA 855);

B. Prevention, detection and suppression of lithium-ion fires at recycling facilities, ruse, recycling and decommissioning of lithium-ion batteries;
C. Viability of extended producer responsibility;
D. Training, education, and other information to better inform the public and first responders regarding lithium-ion battery safety;
E. Other global issues the Commission may consider useful for enhancing the safety and reuse of batteries in the State.

2. Key Learnings from Field Experiences
   A. Incident Response – Emergency Response Guides – standardization; Re-ignition is a big problem; Defensive Posture; Do NOT Enter if RISK of explosion is unknown; ISO containers w/ single entry/exit are not safe to enter; PPE and remove bystanders from area!; Vapor cloud exposure risk, Arcflash risk; Deflagration panels may not work as designed, Reignition, long latency risks; Emergency plugs do not work on all vehicles; No mfr ERG's recommend piercing/puncture, Submersion – most OEM's do not recommend; Parking structures – most structural elements only have 15 minute burn requirements; Fire Blankets – protect nearby vehicles, risk if improperly used; Metal exposure risk; Large vehicle transport challenges.
   B. Design Innovations/Improvements – Thermal Propagation" does not describe the physics; Isolate/Insulate Cells – Non-Propagation designs; Cell venting detection; Improved BMS communication of hazards; Active Cooling in response to venting; Hot particle trapping; Dielectric coolants; Safer Chemistries; reduced use of HFP's; Plume propagation modeling; EVSE/Chargers -propose for "e-stop".
3. Amphenol Vehicle Electrification Portfolio – DC/DC, Battery Pack, Power Distribution Unit, Charger, PTC, AC, Motor Control Unit, Motor Pathway Model.
4. Amphenol ESS Portfolio - HV connections & assemblies, Cell connection, Busbars, Sensors, Other
5. EVSE Charger Portfolio – DC Charging Station: Service Access Panel, User Interface, Communications, Power Module, Electrical Distribution, Auxiliary Power Supply, Charging Plug
6. Amphenol Sensor Portfolio – Temperature, Pressure Gas Detection, Humidity, Concentration, Current Agular Position, Linear Position, Speed, Acceleration/Vibration, Level, Validation, Transducers
7. Critical Electrification Sensors – Battery, Inverter, Thermal Management, Charger
8. Active NAATBatt Committees – Recycling Committee, Manufacturing in NA Committee, Education Committee, Energy Materials Committee, Zinc Battery Committee, Tracking and Tracing Committee, Policy and Regulatory Committee, Lithium Battery Safety Committee, Markets Committee, Military Batteries Committee, Onshoring Battery Technology Committee, 2nd Life Use Committee, Electrode Materials Committee,
9. 100 SAE EV, Hybrid, and Fuel Cell Vehicle Published Documents – Fuel Cell Fueling, Fuel Cell Testing, Fuel Cell Systems, EV Battery Recycling/Secondary, Energy Transfer Systems, EV, Hybrid, Fuel Cell Vehicle Safety, Battery Testing, EV, Hybrid, Fuel Cell Vehicle Technology, EV, Hybrid, Fuel Cell Vehicle Crash Safety, EV Charging Safety, EV, Hybrid, Fuel Cell Vehicle Economy, Range/Power, EV Charging & Grid Communications.
10. Vehicle Battery Standards Steering Committee – 750+ Committee Membership Individual Participants, 171 Represented Employers (OEM's Suppliers, Government and Academia), 32 Subcommittees, 40 Published Documents.

11. Vehicle Battery Standards Steering Committee – BSSC Committees: Q1 2023 – Highlighted: BC4 Battery Standards Label & Tape Committee, BC4 Battery Transportation Committee, BC9 Battery Standards Advanced Battery Concepts Committee, BC10 Battery Standards Recycling Committee, BC10 Battery Standards Recycling Committee, BC 11 Battery Global Traceability Committee, BC15 Secondary Battery Use Committee, BC 18 Battery Field Discharge and Disconnect Committee, BC26 Micro-mobility Battery Standards Committee, Fir Responders Task Force.
12. New York First State w/ Legislation to Mark Vehicles Per SAE – SAE Issued Recommended Practice J3108/1 on March 1, 2024.
13. HV Disconnects are Not Standardized.- 1)Pull plugs by hand (typically hidden), 2)Cut loops requiring cable cutter, 3)Cut loops requiring circular saw, 4) Twist Knob by hand (typically hidden), 5)Fuse-hard for gloved hand.
14. Electric Vehicle Firefighting Has Differences – 1)Need to adapt existing formal written risk management plans, 2)Procedures are changing fast, 3)Previously called for universally cutting cut-loops Tesla & GM now – Only cut firefighter loops if necessary, 4)Tesla was silent on submerging – Now recommend against, 5)GM – Flooding cabin can cool some batteries (Ultium), 5)Li-ion: 13% re-ignite so be ready – prepare and equp driver.
15. Regulatory Update – Electric Power Research Institute – Transportation Standards Update: 1)FMVSS305a – National Highway Traffic Stationary Administration, 2)GTR 20 Phase 2/UN ECE R100, 3)Battery Energy Stationary Storage (NFPA 855/ 70/ UL9540), 4) Transport & Storage: CFR49, 5)REGS & STANDARDS CHALLENGED TO KEEP UP W/ TECHNOLOGY CHANGES IN THE FIELD.
16. EU BESS Regulations – Joint Research Ctr Missions – 1) Safety of Li-ion batteries from electrically propelled road vehicles for use in stationary applications, 2)Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety Requirements for secondary lithium cells and batteries, for use in industrial applications, 3)Stationary energy storage systems w/ lithium batteries in residential and small commercial applications – safety Requirements.
17. Why are Lithium-ion Battery Fires So Pernicious? – 1)Lithium-ion cells undergoing thermal runaway can provide their own oxygen as a reactant, 2)Battery TR releases hazardous and flammable gases and electrolytes, 3)Battery packs in EV's and ESS applications can be difficult to access, 4)HAZARDS PROXIMATE TO PACK INCLUDE: FIRE/EXPLOSION, HAZARDOUS GAS/ASPHYXIATION, HV DISCHARGE.
18. Typical Clearance Standards – IEC 60664-1:2020…and why they do not apply when lithium-ion battery cells vent…Lithium-ion battery system design engineers generally use standards such as IEC60664 – However, the minimum clearances specified in the standard do not apply where ionized gases are present. The Standard does not deal w/ distances: through gases other than air.
19. Anatomy of Cell Failure and available Detection Technology – 1)Causes, 2)Indicators, 3)Detection Technologies. Each sensor technology has strengths and weakness.
20. Venting Explosive Gases – Cell Venting: Cell venting, even without fire, releases flammable gases into pack vapor space, where any ignition source can initiate fire/explosion.
21. Thermal Energy Available for gas ignition: Cascading TR within enclosures: 1)Flash Point, 2)Autoignition Temperature – Cell temps during venting/TR can approach 1000 degree C, providing ample thermal energy for gas autoignition provided sufficient reactants and oxygen are present between LEL and UFL. Thermite Reactions are a pyrotechnic composition of metal powder and metal oxide.

22. Hazardous Gas Release (Lebedeva, Prenmath, etal) – Summary Conclusions.
23. Li-ion Cell TR Gas Release Across Electrochemistries – Total Gas Release During Thermal Runaway for 100% Cells.
24. KATECH EV Testing Presented at TP SIG – Hydrogen-drive VCE's are now considered to be significant in EV's & BESS Applications
25. Gas Evolution and Cascading TR: 1)Relationship between signals and environment, 2)Cascading TR – Multiphysics sensors w/ high concentration calibrations can track performance of TR countermeasures.
26. CATARC Study on Propagation: Observation w/ no TP Judgement – Latency and re-ignition is from damaged packs significant risk to first/second responders! When is a battery "safe"?
27. Arc Flash w/ Cell Venting – 1) Failing cell ejects is an ionized plasma consisting of Hydrogen, carbon dioxide, carbon monoxide, water vapor, aluminum and copper particles, volatile organic compounds, and Carbonaceous soot. 2) IEC 60664 does not apply for post cell venting for creepage and clearance.- "The minimum clearances specified in this document do not apply where ionized gases are present". Arcflash critical voltages appear to be <48V in high density events.
28. Four Types of Battery Fire or Explosion Hazard – 1)Free Burning Fire – Flammable gas finds ignition source, 2)Jet Fire – Example: Electric Vehicle Vents, 3) Flash Fire – Sub-sonic flame front through flammable gas cloud, 4) Vapor cloud explosion. Vented gas in flammable range ignites and develops pressure. May be supersonic flame front for may be pressure build-up in an enclosed space.
29. Birmingham Dry Van (Box) Trailer Case – Flying J Truck Stop, 3/31/2023: 1)Dry Van box trailer contained barrels of batteries to be recycled, 2)Driver drove about 1,800 miles from Las Vegas, NV, 3)Parked two days before explosion to visit family, 4)Witnesses reported roof reach 700 ft, 4) Barrels of batteries found marked Class 9, 5)Barrel contents found inadequately packaged.
30. Hydro-Deflagration to Detonation – 1)<4% Vapor- Vapor Vents Away, 2)4-11% Vapor flammable - Fire Possible, 3) 11% - 70% Detonation Range - Fire or Explosion, 4) >74% Exceeds UEI - Explodes when vented.
31. Calculating DDT Force in the Birmingham Trailer
32. Vapor Cloud Explosions from Cell Venting –

    A. New SAE Committee TEVVBC 30 Battery Pack Venting Committee – Recognition that hydrogen has broad flammability limit, extremely fast propagation (speed of sound), and event physics are thermobaric detonation, not conventional combustion VCE videos.

    B. SAE Draft Recommendations: 1)Separate vent gases from HV conductors to reduce risk of arcflash, 2)Minimize air volume to reduce risk of internal fire/insulate conductors, 3)Separate particles before leaving pack to prevent ignition of plume from hot particles, 4)Keep gases below autoignition temperature (<450 C) outside pack. SAE recommendations reduce risk of VCE, more research and modeling needed.
33. SAE Pack Venting Committee – New SAE Committee TEVVBC 30 Battery Pack Venting Committee – Plans to establish Technical Information Report and Guidance Document 2024.
34. Best Practices – Active & Passive: 1)Passive isolation of venting paths; insulating HV bus work, 2) Active: Detection and Active Cooling – Best Practices show significant improvement in outcomes of cell venting.
35. Gas Detection – Capable Technology and Supply Base: 1)Early venting detection based on carbonate, CO, CO2, H2 sensing, 2)Application Spaces – Best Practices show significant improvement in outcomes of cell venting.

36. Safety & Research Resources
37. GB 29743.2: National Standard of the People's Republic of China: 1) GB Standard, 2)Important: GB29743.2 is a mandatory standard.
38. GB29743.2 Timing – Reduced Conductive Coolant < 100uS/cm – 2023 – 2026
39. Electrical Conductivity Over Time – eCond will increase overtime due to multiple factors.
40. Elastomer and thermoplastic compatibility – Standard qualities of the following classes of polymers are expected to be compatible: Nitrate rubber (NBR), Hydrogenated Nitrile rubber (H-NBR), Acrylate rubber (AEM, ACM), Silicone rubber (MVQ), Fluorocarbon rubber – Viton (FPM), Ethylene Propylene Diene rubber (EPDM), Butyl rubber (BR), Natural rubber (NR), Syrene Butadiene rubber (SBR), Polychlorophene rubber – Neoprene (CR), Polytetrafluoroethyiene – Teflop (PTFE), Polyethylene low – and high density (LDPE, HDPE), Polypropylene (PP), Polyvinylcloride (PVC), Polyamide (PA), Polyester resins (UP) – Maximum and minimum and usage temperatures depend on the quality of the elastomer and should be requested at the manufacturer of the elastomer.
41. Chinese Standard – GB 29743 – Part 2
42 NHTSA Water Intrusion Study – Study examining vehicles similar to xEV's that suffered ignition events post-flooding has demonstrated concerns w/ pack design and manufacturing.- Report has shown design and manufacturing issues & need for minimum industry standards.
43. Electric Vehicles and Battery Safety: 1)Recent hurricanes in FL have revealed seawater flooded EVs pose major safety concern to passengers, emergency responders, and recovery personnel, 2)The 2022 Hurricane Ian impacted between 3000-5000 EVs tp various degrees, 3)Hurricaine Idalia in 2023 also caused several EVs to catch on fire, although the numbers were lower than the hurricane Ian due to a relatively weaker hurricane Idalia, raised public awareness to move EVs to higher grounds, 4)Spontaneous EV fires have also been reported after accidental EV immersion (e.g., in boat ramps) – A comprehensive understanding of the EV/battery failure mode in saltwater immersion scenarios is required.
45, Selected EVS for Teardown Study – 1)Hurricane Ian flood damaged EVs collected, 2)Figured showing the approximate flood line, 3)No observable fire damage from these vehicles.
46. Selected EVS for Teardown Study – Summary of 10 Vehicle Makes.
47. Looking Forward – Additional efforts ongoing to obtain a comprehensive understanding of the flood induced events observed in the field and identifying the root causes: 1)A few more teardowns, 2)Controlled immersion tests.
48. J2990/ISO 17840 Documents Overview
49. Project Worldwide Uniform Information for Responders

At the end of the presentation, Presenter Brian Engle entertained questions and comments from the Commission. Brian Engle reported that he will provide the presentation slides to the Committee for future reference. Mr. Engle pointed out the importance of training for first responders to assure they have basic knowledge about electrified products and the potential hazards. Mr. Engle further reported that his agency is working directly with UL across SAFE and a whole host of other bodies including ISO to assure the effort is all on a continuum where response guidance to battery incidents is provided in a standardized format, and easily comprehensible.

Additionally, Mr. Engle reported the importance of Passive Propagation Resistance and pushing designers to: a) produce systems that don't propagate, and b) learning to deal in a safe fashion with the gases when they are released. Mr. Engle also added that consumer education is vital to hazard reduction as consumers

need to understand that lithium-ion battery cells can hold charges for years and don't self-discharge like alkaline batteries. Certain critical steps in consumer recycling should include the following: placing tape over open terminals and placing batteries in plastic sealable bags prior to dropping off at recycling centers. Mr. Engle further stated that his agency is currently working with the EPA on this initiative.

Mr. Engle touched on the topic of transport and storage of the systems and the continual increase of hazardous incidents. Mr. Engle further discussed the importance of transportation standards being met as well as the use of technology advanced monitoring systems at the recycling centers.

Chairman Nusbaum thanked Mr. Engle for his thorough presentation, and sharing his knowledge on the subject base with the Commission. Chairman Nusbaum further questioned how to further mitigate fire risk in Maryland especially since the Port of Baltimore imports the most EV's than any other Port (approximately three quarters of a million vehicles per year).

Commission Member Sanchez recommended the Commission contact the Florida State Fire Marshal's Office as they have developed some really great standards and practices and have hosted lithium-ion battery symposiums for First Responders. Brian Engle added that the State of Florida has put in place an active tracking system that during a flood event provides Frist Responders/Responders the ability to enter encounter data on a website or phone app of damaged batteries undergoing thermal runaway or batteries that are at risk, thereby enabling geolocation and proper handling.

Chairman Nusbaum moved to the next agenda item which included a Presentation from Marc Boolish, Director PRBA – Rechargeable Battery Association. The highlights of the Commission Member Boolish's presentation, PRBA are summarized as follows:

1. EPA medium form labeling for collection and recycling – January 2025
2. PRBA – The Rechargeable Batteries – Details of meeting:
3. State Portable and EV Battery EPR:
    A. Initiatives in 18 states w/ different laws at various levels
    B. Review of States and current State levels of legislation/bills – California, Vermont, Illinois and Washington State have current legislation. New Jersey has the only EV Legislation. California reintroduced EV bill in House/Senate as prior bill was vetoed. Nevada, Colorado and New Mexico are interested in some type of EV legislation. Washington, Illinois and Vermont are looking at embedded batteries as separate legislation. Oregon has introduced active legislation. Iowa is working on a study bill. Minnesota and Wisconsin working on possible bills. Illinois is the current general model for legislation and Oklahoma has legislation in the works based on Illinois. Missouri has bill that focuses on lithium-ion batteries. Pennsylvania has proposed bill modeled after Illinois. Massachusetts has bill modeled after Illinois. Connecticut introduced bill in 2024 that looks similar to Illinois, but timed out in the Senate. New Jersey has nothing yet, but is looking into composing.
4. Canada – EPR Initiatives
    A. Recently passed
    B. Legislative Activity
    C. Existing
    D. Existing w/ New Activity
    E. Voluntary Program

5. European Union
    A. All Batteries
    B. Rechargeable
    C. None
    D. Not Required
6. World Prospectives
    A. Active – Red
    B. Pending – Yellow
    C. Not Proactive - Orange

Commissioner Member/Presentor Boolish opened the floor to questions or comments regarding his presentation. Commissioner Nusbaum thanked Commissioner Boolish for his informative and detailed presentation.

Commission Member Kitty McIlroy provided an update to the Commission regarding Maryland's current legislative battery safety bill initiates. Commissioner McIlroy reported currently there are two different efforts going on with one effort directly related to batteries. One of the initiatives relates to electronics with battery safety included. She has been working with Senator Augustine and Delegate Stein on the electronics bill, with the goal to update the 20-year old electronics EPR Law, but the bill does not fund anything in the State. Other efforts include addendums to the battery bill providing permanent funding to finance collection sites for battery fire detection, suppression and extinguishing equipment, and funding the recycling contracts and staff employed at those sites. The battery bill is not expected to pass at this time. Kitty McIlroy and her team will be testifying in favor of the electronics bill and testify favorably regarding amending the battery bill. A request will be made to hold the battery bill until this Commission finishes the tasks at hand and provides a report to the legislative body. Commissioner McIlroy further added that it would be optimal and preferred to have a standalone bill for batteries to avoid mixing with other categories to diminish the potential for complications, for which she will work with the legislators on that stance.

Commission Member Boolish was asked about the Illinois bill and what it entails. Commissioner Boolish reported that the Illinois bill focuses on small and medium format type batteries, requires that the producers be responsible and requires the collection of a stewardship organization or organizations. The law goes into effect in 2027. Also, the legislation requires filing annual reports, paying a fee, and reimbursing the State agencies and municipalities for the collection and recycling activities.

The Subcommittee leaders provided the Commission with updates and plans for future meetings.

Commissioner Haley Kotzker reported the Public Service Commission approved some regulations from the Maryland Energy Storage Initiative Working Group which outline programs that will lead towards the procurement of 3,000 megawatts of long duration energy storage by 2033. The regulations require the long duration energy storage systems adhere to NFPA 855 standards. Commissioner Kotzker will be working with the group in the future to align goals and initiatives to keep the State safe.

Commissioner Ken Bush provided the Commission with an update regarding the State's adoption of the 2024 version of NFPA 1 Fire Code and NFPA 101 Safety Code for which both of the NFPA Codes reference the all/most current 2023 NFPA 855 Codes. Commissioner Bush reported the updated Codes are scheduled to be published in the Maryland Register on February 7, 2025, and then awaits a 30-day public comment period

before progressing to the next step which is to be reviewed and possibly approved/adopted by the Maryland State Fire Commission. If approved by the Maryland State Fire Commission, the document will become effective no sooner than 10 days after the approval date.

Emil Nusbaum thanked Chris Pilzer for opening his recycling facility to the Commission which included a great tour and the provision of demonstrations revealing some of the issues and hazards facing the recycling industry.

The Commission will continue to identify and invite focus groups/guest speakers to present at future Commission meetings. The Commission also discussed various upcoming/future demonstrations related to the Commission's topics of interest. More information will be provided at a later date.

The next in person Commission meeting was scheduled for Thursday, March 6th at 10:00 a.m. at MFRI in Classroom I.

Chair Emil Nusbaum asked if there was any additional business the group members wished to address, and upon hearing none, the meeting was adjourned at 12:18 p.m.

These meeting minutes are respectfully submitted by Penny L. Doty.