21 December 2023

IUMI Policy Agenda

11. Safe transport of electric vehicles (EVs)

Brief description

In light of the drive to decarbonize all modes of transport, the number of new energy vehicles has been on the rise. The European Automobile Manufacturers Association (ACEA) has collected passenger car registration data in the EU per fuel type which show a significant growth of alternative fuel vehicles (AFVs) registered. Electric vehicles (EVs) are projected to match the sales of internal combustion engine (ICE) vehicles by 2030, and to surpass them by 2040.

Battery electric vehicles are usually fitted with a lithium-ion traction battery which is encapsulated and shielded by the vehicle's body. The battery pack consists of various battery modules which in turn are comprised of several battery cells. The chemical process which produces electricity that can be used for propulsion of the EV takes place within the battery packs. The battery system is usually placed in the vehicle floor or undercarriage where it is protected from damage by an anti-crash frame.

Electric vehicles have extensive safety systems designed to automatically shut down the power and isolate the battery pack when a collision or a short circuit is detected. An important safety feature of EV battery packs are in-built battery management systems (BMS). The BMS monitors and controls the battery and is a crucial factor in ensuring EV safety. It safeguards both the user and the battery by ensuring that the cell operates within its safe operating parameters. It monitors the state of a cell as represented by parameters.

The state of charge (SoC) is an electrical cell or battery’s charge level compared to the total capacity of the cell or battery. Batteries at high SOCs have been shown to experience more violent reactions during thermal runaway. Testing has indicated that high SoC cells produce higher heat release rates, maximum temperatures, and concentrations of flammable and toxic gases during thermal runway events. However, while the SoC does affect the growth and peak heat release, it does not affect the total heat release.

Despite this inherently safe design thermal runaway may occur if a cell is abused, e.g. by heat, mechanical damage or overcharge. Thermal runaway can also occur as a consequence of a cell or battery manufacturing error. When thermal runaway occurs, the cell is undergoing an unstable chemical reaction that is difficult to bring under control. At some point, the separator structure collapses and the electrodes touch, causing an internal short circuit and masses of heat, bringing the cell to ever higher temperatures and generating toxic and flammable gases. Cell heating will continue until the rise in temperature exceeds the heat that can be dissipated to the cell's construction. This released heat will then increase and start to affect other nearby battery cells. When the generation of heat becomes self-sustaining - the heat releases energy and the energy in turn releases more heat - the overheating propagates from cell to cell and the battery is in thermal runaway.

The high safety standards integrated into EV traction batteries, including solid casings and the BMS, make the likelihood of damage to an EV battery pack and thermal runaway extremely low. However, in view of the low possibility for thermal runaway the significance of the BMS as incorporated into EVs is particularly relevant. These safety systems prevent the battery cells from over and under charging, and thus prevent thermal runaway. It is important to note that BMS are not incorporated into smaller capacity and less sophisticated vehicles such as electric bikes or scooters.

As statistics continue to be gathered, it is currently estimated that, in general, there are fewer fires from EVs compared with fires from conventional vehicles when compared over the same distance.

A thermal runaway in a Lithium-Ion battery is difficult to extinguish unless the firefighting agents are injected directly into the battery to enable efficient cooling. If a fire breaks out in an EV or in an ICEV (internal combustion engine vehicle), activities in support of early detection and verification/confirmation, early fire suppression and boundary cooling are critical actions to stop the spread of the fire to the battery and to adjacent vehicles.

A particularity of EVs is the risk of re-ignition which tends to be higher for a longer period than for ICEVs. Precautionary measures to avoid re-ignition of the traction battery must therefore be taken for an extended period after a fire has been extinguished.

IUMI published a recommendations and best practice paper in September 2023 which includes technical information about EVs as well as best practice for the safe transport of EVs on board PCTCs and roro vessels.

The IMO's Sub-Committee on Ship Systems and Equipment has an agenda item titled "Evaluation of adequacy of fire protection, detection and extinction arrangements in vehicle, special category and ro-ro spaces in order to reduce the fire risk of ships carrying new energy vehicles" on the agenda for its 10th session in March 2024.

Relevant authority / organisations and documents

- IUMI:
  - Best practice & recommendations for the safe carriage of electric vehicles (EVs), September 2023
  - Participation in the EU LASHFIRE Project with the aim to significantly reduce the risk of fires on board ro-ro ships, 2019-2023
  - Participation in the COFFEE Project to assess effectiveness of CO2 as extinguishing medium, launch of project planned for 2024

Timeline / important dates

- IMO:
    - SSE 10, March 2024: Agenda item 16 “Evaluation of adequacy of fire protection, detection and extinction arrangements in vehicle, special category and ro-ro spaces in order to reduce the fire risk of ships carrying new energy vehicles”

IUMI will:

- IUMI will be involved in the IMO’s work to effect appropriate safety measures to address this new risk.