



Safe shipment of Electrical Vehicles (EVs) at sea

Probability of fire in EVs

It is estimated that, there are fewer fires from EVs compared with fires from conventional vehicles when driven over the same distance. Statistics indicate that the probability of an EV fire is lower than that of a fire in an internal combustion engine vehicle (ICEV) relative to the total number of vehicles.

Differences between PCTCs and roll-on/ropax

Pure car and truck carriers (PCTCs) and roll-on/roll-off (roro/ropax) vessels have significant differences in their design, hence many safety measures, risk control options and incident responses are different on these ship types. PCTCs are equipped with CO₂ or Foam based extinguishing systems onboard. Roll-on/roll-off vessels are equipped with water drencher (sprinkler) extinguishing systems.

There has been research on roro vessels, the EU's LASH FIRE project, but very little research regarding fire extinguishing of electric vehicles onboard PCTCs.



The roll-on/roll-off (roro/ropax) ship

The roro/ropax ships are designed to carry wheeled cargo on 1-5 different decks such as cars, motorcycles, trucks, trailers, and buses which are driven on and off the ship on their own wheels. Roro vessels are equipped with water drencher (sprinkler) extinguishing systems. Ropax vessels are designed in the same way on cargo deck but are also carrying between 13 - 3000 passengers.

It is common that the cargo consists of a mix of new and used vehicles like cars both EVs and ICEVs, trucks, trailers, buses, and other heavy constructions at the same time.

Car Carrier - Pure car and truck carriers (PCTCs)

Pure car and truck carriers are purpose-built vessels for the transportation of different types of rolling cargo, e.g., new and used passenger cars and trucks, heavy construction equipment, and other heavy loads. PCTCs are equipped with CO₂ or Foam based extinguishing systems.

PCTCs are usually configured with 10-13 decks for the loading of different vehicle types. The height between the decks can be adjusted depending on the types of vehicles being transported. The height of the vehicle decks is extremely low to reduce the loss of cargo space. Adjustable decks further optimize the cargo space. The vehicles are loaded with very little space between them. This impedes quick access to specific cars.

PCTCs alongside in ports

A particular challenge associated with PCTCs moored in ports, is fire, because the CO₂-extinguishing systems cannot be used. When both the internal doors and the stern/side ramps are open during the loading process the CO₂ cannot be contained within the vessel. Foam based extinguishing systems are less effective due to the uneven airflow which distracts even spread of the foam. Due to their construction the ramps cannot be closed quickly. External firefighting teams are in general not familiar with the design of vessels and are not trained to fight fires in such environments.



Recommendations and best practice from The International Union of Marine Insurance (IUMI) -

In August 2023, the International Union of Marine Insurance (IUMI) published their extensive report, *Best practice & recommendations for the safe carriage of electric vehicles (EVs)*. To learn more about how to ship electric vehicles safely, from the loading process to firefighting recommendations, please see the full report.

Loading process and loading condition of cars

In light of the safety systems incorporated into EVs, new cars present a lower risk as compared to used vehicles. Used cars may have had accidents causing mechanical damages which may negatively impact the intactness of the battery pack.

- Roros & PCTCs: A clear policy on the cargo which is accepted/rejected for ro-ro spaces should be in place. Vehicles should be screened and used/second-hand vehicles in particular should be carefully checked before being allowed on board. If there is suspicion that the battery of an EV is damaged or defective, they should only be allowed if their battery is removed and if they are free from leakages. International Maritime Dangerous Goods Code (IMDG) Special Provisions 961 and 962 address requirements for vehicles which are being carried on board a vessel.

Charging on board

- ROROs: charging on board ro-ro passenger ships can be permitted if the ship operator conducts a comprehensive risk assessment and approves and implements appropriate risk control measures. Research indicates that charging an EV on board is the safer option as inbuilt safety mechanisms are activated during charging. Information regarding safe charging on board is available in the European Maritime Safety Agency (EMSA) Guidance on the carriage of alternative fuel vehicles (AFVs) in ro-ro spaces.
- PCTCs are not fitted with charging stations.

Detection & confirmation/verification

- Roros & PCTCs: detection and confirmation/verification of a fire is key to enable successful firefighting operations. These two steps should not be considered as separate but as one step. Time between detection and confirmation/verification must be reduced to the shortest possible time. The installation of technologies which enhance early detection are therefore supported for these vessel types. Options include gas detection systems, thermal imaging cameras, and AI powered systems.



Firefighting

- Roros: the EU's LASH FIRE project has shown that drencher systems are effective to fight fires on board ro-ro and ropax vessels. Full scale tests show that a drencher system has the same impact on the fire regardless of the source of the fire being an ICEV or an EV. Drencher systems are thus effective to manage and control EV fires.
- PCTCs: CO₂ extinguishing systems **if applied quickly** after the detection and verification/confirmation of a fire have worked successfully to fight fires on board PCTCs. To further improve the usefulness, **the CO₂ capacity should be doubled on board PCTCs**. Research projects are ongoing to methodically assess and evaluate the effectiveness of the CO₂ extinguishing systems.
- PCTCs: research indicates that while high-expansion foam fire extinguishing systems were unable to stop thermal runaway (like any other fixed systems), it hindered the ignition of flammable gas, including gaseous electrolyte from the batteries. The system effectively prevented heat transmission from a vehicle on fire if it was submerged in the foam. This suggests the potential effectiveness of high-expansion foam fire extinguishing systems.
- PCTCs: early detection, confirmation/verification and a short response time are crucial to fight a fire successfully. **The fixed firefighting systems should be applied first rather than manual firefighting by the crew.**

Overarching approach

- PCTCs and roros: different design, resources, equipment, and circumstances must be considered for each vessel. Individual risk assessments and tactics are essential to ensure an effective response in case of a fire on board.

About IUMI

The International Union of Marine Insurance (IUMI) represents 42 national and marine market insurance and reinsurance associations. As a forum for the exchange of ideas and best practice, IUMI works to raise standards across the industry and provides opportunities for education and the collection and publication of industry statistics. IUMI is headquartered in Hamburg and traces its roots back to 1874. More information can be found at International Union of Marine Insurance (iumi.com).



Best practice & recommendations for the safe carriage of electric vehicles (EVs) 2023