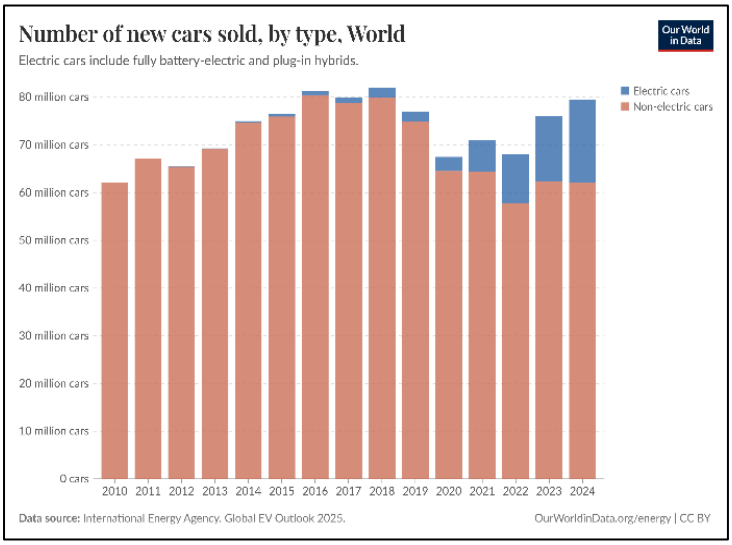
Risk Management for the Carriage of Electric Vehicles (EVs)

Introduction

The carriage of electric vehicles (EVs) onboard vehicle carriers (PCTCs), Ro-Ro vessels and in some cases container ships, continues to increase as governments introduce new policies and incentives to support lower emission transport systems, and manufacturers accelerate production to meet rising global demand. EVs use lithium-ion battery pack systems as their primary energy source. If a lithium-ion battery is damaged or experiences a failure, possibly caused by internal short circuits, mechanical or physical damage, heat damage and/or manufacturing defects, thermal runaway may occur, during which heat can propagate rapidly within the battery cell. Thermal runaway can develop when internal heat generation exceeds the ability of a battery cell to release heat effectively.



Source: International Energy Agency. Global EV Outlook 2025. – processed by Our World in Data

The increasing demand for EV carriage introduces important safety considerations for shipping companies, crew and operators. Fires involving lithium-ion batteries may behave differently from those associated with internal combustion engine (ICE) vehicles and traditional shipboard firefighting equipment may not fully address the challenges posed by thermal runaway. This Risk Alert outlines key risks, relevant industry developments and practical measures to support improved readiness and response time to fire incidents onboard.

Evolving Carriage and Risk Considerations

While EVs (lithium-ion battery powered vehicles) are often regarded as a relatively new technology, they have been shipped globally for over a decade. However, the rapid increase in EV shipments via PCTCs, Ro-Ro vessels and container ships has recently intensified industry focus on their safety profiles. Stakeholder opinions appear divided: some view EVs as a significantly higher risk due to unique lithium-ion battery fire dynamics, while others maintain that their overall risk level is comparable to that of internal combustion engine (ICE) vehicles.

Despite differing views on risk, with the global transition towards lower emission transport continuing, shipments of EVs are expected to increase in the coming years. Existing maritime regulatory frameworks may not fully address all risks associated with thermal runaway, however the maritime industry has a history of adapting to emerging risks and new technologies. In this context, some of the Club's members have taken early steps to support effective risk management, in certain cases exceeding current regulatory requirements through the adoption of new and innovative technologies and improved crew training.

Risk management considerations may begin before shipment and during the stowage planning phase. For new EVs shipped directly from manufacturers, early engagement with the manufacturer can help clarify handling arrangements and identify whether any additional precautions may be relevant. Effective cooperation with stevedoring companies is also important, as they routinely handle EVs and may be aware of potential issues affecting individual vehicles. Where concerns are identified, these should be clarified prior to loading and EVs with identified issues excluded from the shipment. During the stowage planning stage and where practicable, EVs should be stowed together and segregated from ICE vehicles.

Understanding Fire Behaviour and Associated Challenges

Lithium-ion battery failures can result in thermal runaway, where heat increases rapidly and may lead to the release of toxic smoke, flammable vapours and very high temperatures. The behaviour of lithium-ion battery fires may include the following characteristics –

- Rapid escalation of fire with limited early warning or no warning at all
- High temperatures during burning
- Release of toxic gases during an incident
- Potentially reduced effectiveness of traditional fixed firefighting systems
- Restricted or unsafe access to affected car decks during an incident
- Re-ignition of fire, where a fire appears to have been extinguished

The condition and state of charge (SoC) of lithium-ion batteries may influence fire behaviour and incident development. Awareness of battery condition and SoC levels, including agreement with manufacturers on an appropriate SoC, forms part of effective risk management during the planning, loading and carriage stages. However, these considerations may present operational challenges and require specialised knowledge of the overall operation and an understanding of additional equipment and technologies that are not usually available onboard existing vessels.

Advancements in Detection, Suppression, Extinction and Containment

A range of new technologies is being explored across the maritime industry to enhance both early detection and fire containment capabilities. The availability and suitability of these new technologies may vary depending on vessel design and compatibility with existing fire protection arrangements. These may include:

- Linear heat, infrared flame and gas detection systems for rapid detection
- Image monitoring cameras to provide real time early visual of an incident
- Early activation of fixed firefighting systems to limit fire development
- Water driven penetration firefighting systems for cooling or penetrating the affected vehicles
- Adjustable spray-pattern lightweight hoses for more effective hose management during an incident

These technologies aim to provide early warning of thermal runaway and support a more effective initial response by the crew.

Fixed firefighting systems remain an important part of onboard fire protection, and perform a key role during EV related fires, particularly where manual firefighting is very difficult and probably unsafe on occasions. Early detection facilitates rapid fire assessment and the selection of effective suppression agents. Rapid identification supports the prompt activation of fixed firefighting systems, which is essential for containing the fire and preventing further development.
Current firefighting agents may have limited effectiveness in fully extinguishing a lithium-ion battery in thermal runaway and, as a result, emergency response strategies may place greater emphasis on containment, cooling of battery cells and mitigation of collateral risks.

The Role of Crew Training and Readiness

The distinct nature of EV related fires highlights the importance of crew training and preparedness, alongside advances in firefighting technology. Regular drills and specialised training on lithium-ion battery behaviour, thermal runaway signs and industry response standards are vital for managing EV fire risks.

Scenario-based exercises enhance decision-making and stress early intervention, as standard equipment often struggles with battery fires. Training must keep pace with new fire detection and suppression techniques to tackle EV battery challenges.

Risk Reduction Measures

A combination of new and innovative technologies, robust procedures and properly trained crew provide an effective approach to reducing risk. The following measures may help to minimise exposure to these risks –

- Recognising and responding to early warning signs of thermal runaway
- Rapid activation of fixed firefighting systems for fire involving EVs
- Providing additional specialist firefighting equipment on board the vessel
- Using specialist equipment, where appropriate, to manage thermal runaway
- Providing targeted and regular EV specific training for crew members
- Conducting regular joint drills with shore-based authorities and fire brigades to improve crew decision-making matrices
- Ensuring crew members have a thorough understanding of the vessel’s layout, its systems and response capabilities

These measures support more informed decision making and improve the ability to contain or manage EV related fires. Risk considerations and response planning can vary depending on vessel type and layout, cargo stowage configuration and length of voyage. Factors such as deck general arrangement, ventilation systems and access routes can also influence response time during an EV related fire incident.

Conclusion

As the global fleet carries increasing numbers of EVs, the maritime industry faces new and evolving safety challenges. The combination of modern detection systems, enhanced firefighting techniques and targeted crew training may improve the ability to detect, control and respond to EV related fires. Effective readiness procedures can support safer operations and improved risk control as the carriage of electric vehicles becomes an increasingly established part of global trade.

Supportive Information

For further information on this topic please contact Taslim Imad (Loss Prevention Manager) who represents the Club at the VCSF or alternatively please contact the Loss Prevention Department, Steamship Insurance Management Services Ltd.

Tel: +44 20 7247 5490 Email: ship.surveys@simsl.com

Resources

VCSF Fire Response - High Level Guidelines
IUMI - Risk Mitigation for the Safe Ocean and Short Sea Carriage of Electric Vehicles (EVs)