Submission No 15

ELECTRIC AND HYBRID VEHICLE BATTERIES

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NSW Parliamentary Inquiry into Electric and Hybrid Vehicle Batteries

Joint Standing Committee on Road Safety (Staysafe)

Submission by Australasian Fire and Emergency Service Authorities Council (AFAC)

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1 Introduction

The Australasian Fire and Emergency Service Authorities Council (AFAC) welcomes the opportunity to make a submission to the NSW Joint Standing Committee on Road Safety (Staysafe) in relation to its *Inquiry into Electric and Hybrid Vehicle Batteries (the inquiry).* The submission is based on consultation among AFAC membership as well as our broader understanding of the context of the consultation.

We ask the inquiry to note that the submission should not be taken as the position of any single AFAC member. Also, some of our members will have contributed through jurisdictional submissions, and nothing in this submission should be taken as implying that our members do not fully support their jurisdictional submissions where made.

As part of this submission, numerous documents produced by AFAC have been cited. These documents form the foundation of information used for this submission and are referenced in the text with hyperlinks where possible. AFAC takes a leading stance in the publication of industry doctrine which has been drawn on where relevant. Doctrine ranges from high-level, principles-based capstone material, through to technical guidance. Individual agencies make practical and realistic operational decisions on how they interpret this doctrine.

This submission begins with an overview of AFAC and its role within Australasian fire and emergency services (**Section 2**). **Section 3** is a response to each of the questions provided by the inquiry.

2 Overview of AFAC and its role

AFAC is the National Council for fire, land management and emergency service authorities in Australia and New Zealand. AFAC represents 33 members and 21 affiliate members comprising permanent and part-time personnel and volunteers, totalling approximately 288,000 firefighters and emergency workers. The list of AFAC member organisations is provided in Attachment 1.

AFAC supports the sector to create safer, more resilient communities. We drive national consistency through collaboration, innovation and partnerships. We deliver enhanced capability by developing doctrine and supporting operations. AFAC has no direct role in the delivery of services to the community. AFAC also currently plays no role in representing its members in industrial matters.

Through our collaboration model, which encompasses 34 groups, technical groups and networks, AFAC assists the emergency management sector to identify and achieve strategic priorities. Collaboration occurs through sharing knowledge and exchanging insights, exploring opportunities and creating solutions. This approach enables AFAC members to consider common challenges, generate solutions, develop positions and inspire new directions in practice.

AFAC's most significant intellectual property asset is a suite of doctrine publications which articulates good practice based on the knowledge and experience of our members and informed by research where it is available. It is evidence-based, constantly reviewed and vested as the official view by the AFAC National Council and sector leaders.

AFAC representatives also lead the development on many Australian and International Standards Committees. AFAC and Standards Australia are signatories to a Memorandum of Understanding in the development and revision of standards relating to the management of fire related risks, fire protection and fire safety.

2.1 AFAC Strategic Directions

AFAC's work is guided by the *Strategic Directions for fire and emergency services in Australia and New Zealand 2022-2026*. The Strategic Directions provide the fire and emergency services sector with a shared vision and a joint commitment to enhanced community resilience. It informs, clarifies intent and identifies the actions required at a national level for fire and emergency services in Australia and New Zealand. AFAC recognises that a collaborative approach is critical to achieving the Strategic Directions and gives fire and emergency services a national voice and broader impact, while enhancing collective capabilities.

The Strategic Directions are:

1. Supporting resilient communities through risk reduction
2. Providing a trusted response
3. Using credible and timely information and data
4. Safe, capable and diverse workforce
5. Informed by knowledge, innovation and research
6. Effective and transparent governance.

2.2 AFAC is a managing partner in the Australian Institute for Disaster Resilience

The Australian Institute for Disaster Resilience (AIDR) is the National Institute for disaster risk reduction and resilience. AIDR collaborates across sectors to strengthen the resilience of Australian communities to disasters. AIDR creates, grows, and supports a range of networks; provides opportunities for learning; development, and innovation; shares knowledge and resources to enable informed decision making and action; and facilitates thought leadership through national conversations.

AIDR is supported by its partners: the Australian Government National Emergency Management Agency, AFAC and the Australian Red Cross.

2.3 AFAC supports the National Resource Sharing Centre

AFAC established the National Resource Sharing Centre (NRSC) to develop and maintain the national Arrangement for Interstate Assistance (AIA); pursue collaboration opportunities with international jurisdictions; maintain the National Statement of Capability for Fire and Emergency Services and provide support, if requested, to jurisdictions involved in deployments (https://www.afac.com.au/initiative/nrsc/national-resource-sharing-centre-doctrine/national-resource-sharing-centre-fundamental-doctrine). Its value has been clearly demonstrated in supporting the management of large-scale incidents by facilitating interstate and international deployments.

2.4 AFAC leads the Emergency Management Professionalisation Scheme

The Emergency Management Professionalisation Scheme (EMPS) exists to advance the cause of professionalisation in the practice of emergency management in Australia and New Zealand. Professionalisation is open to all emergency management personnel regardless of whether they are paid or volunteer, and regardless of the particular emergency management function they undertake.

EMPS provides an excellent example of a national approach for professionalisation in the industry.

2.5 AFAC are the custodian of the Australasian Inter-service Incident Management System (AIIMS)

AIIMS is the nationally endorsed system for managing incidents used by all fire, emergency service and land management agencies within Australia. AIIMS provides a common incident management system for all responding organisations and personnel, enabling seamless integration of activities and resources for the effective and safe resolution of any incident.

Through the application of AIIMS in training, exercising and incident response, people from fire and emergency services, government, not-for-profit agencies and industry have been able to build trust and confidence in each other's ability to work together and effectively manage the most challenging of incidents.

2.6 AFAC and the National Aerial Firefighting Centre

AFAC provides aerial firefighting resources on behalf of the states and territories.

The National Aerial Firefighting Centre (NAFC) is a business unit of AFAC formed in 2003 by the Australian states and territories, with the support of the Australian Government, to provide a cooperative national arrangement for the provision of aerial firefighting resources for combating bushfires.

NAFC coordinates the leasing of a national fleet of specialised firefighting aircraft on behalf of state and territory emergency services and facilitates the sharing of these aircraft between states and territories during the fire season. The collaborative arrangements for the national aerial firefighting fleet have been instrumental in protecting communities and saving lives and property over past bushfire seasons.

NAFC also provides national systems to service aerial firefighting. For example, ARENA is a ground-breaking information system developed collaboratively with states and territories to support effective management and administration of the fleet.

3 Comments on the Terms of Reference

There are several AFAC collaboration groups that are made up of subject matter experts from our member organisations that have an interest in the uptake of EVs. These include the Urban Operations Group, SES Operations Group, Rescue Technical Group, Alternative and Renewable Energy Technologies Working Group, Community Safety Group, Built Environment and Planning Technical Group, Climate Change Group and the Fleet Technical Group.

AFAC has produced research and evidence-based considerations that are apolitical and are focussed on the safe implementation and uptake of electric vehicles (EVs). This includes a guideline for emergency service organisations to consider when responding to emergency incidents involving electric vehicles, along with advocating for safer, more appropriate building standards particularly relating to carparks and charging infrastructure.

Lithium-ion batteries (LiB) used in EVs present a number of hazards and risks to first responders and emergency service personnel, and to the public when involved in an incident.

There are questions posed in the Terms of Reference that are relevant to AFAC's role in advocating for public safety related to the implementation of EVs and EV charging infrastructure.

3.1 Responses to specific questions:

(a) the risk and management of fires and other issues caused by batteries in electric and hybrid vehicles, including light electric vehicles

When LiBs (in any application) fail, they present challenges for emergency responders. AFAC suggests that the inquiry consider that while failure events may currently be occurring at a relatively low frequency, the potential risks and hazards that can eventuate from a thermal runaway event may be of high consequence. A failure event within a LiB due to equipment faults and defects, overcharge, electrical failure, mechanical or thermal abuse may pose the following significant challenges for firefighters in the management of the incident:

- Thermal runaway – an exothermic chemical reaction involving intense, uncontrollable heating, often followed by the violent release of highly toxic, corrosive, flammable, and potentially explosive vapours, and intense, directional, jet-like flames.
- Stranded electrical energy within large battery packs and installations that present significant fire and electric shock risks.
- Complex and protracted extinguishment and cooling of water applied directly to the battery to fully extinguish and cool down an EV battery fire.
- Toxic fire emissions and effluents, including the containment of large amounts of contaminated fire water that may pollute soil, groundwater and nearby waterways.
- Secondary ignitions, that may occur without warning some time after the initial event, potentially during recovery, transport, storage, and disposal.

With the growing number of EV types, models, and variants available, emergency responders potentially must deal with a large variety of battery locations, configurations, chemistries, formats,

and response procedures during any incidents involving these alternatively powered vehicles and products.

Fire and emergency service organisations need awareness of, and evidence-based procedures, equipment and training for high consequence incidents involving EVs. These include road incidents and crashes (including in tunnels), and fires when parked in domestic garages and underground or covered car parks.

Current design requirements for buildings and road infrastructure do not include specific considerations or provisions for EV battery failures and fires. Existing fire safety systems and measures may not be adequate in these fires, which are long in duration and can produce intense heat and large volumes of toxic fire gases, especially when multiple EVs are involved. Car park and ferry fires around the world have highlighted the speed at which fires involving modern vehicles can propagate without adequate fire protection, with EVs an added complication for fire suppression and firefighting, smoke/vapour handling and runoff containment.

AFAC suggests developing further measures within the National Construction Code in consultation with Australian fire and emergency service agencies to support easy and safe charging of EVs (as requested at the 26 August 2022 meeting of Building Ministers).

AFAC suggests a further consideration of the impacts of EV fires on building systems and fire and life safety systems in new and existing buildings.

AFAC suggests that guidance should be produced regarding specific risk factors that should be considered when introducing new hazards into environments that were not necessarily designed with them in mind.

AFAC suggests the development of appropriate, stringent security and safety standards relating particularly to EV charging infrastructure.

While current available research may indicate that the measured total heat release rates (HRR) in EV fires are comparable to that of internal combustion vehicle fires, giving rise to conclusions that EVs pose no significant increased risk in fires, AFAC members have highlighted the below considerations in reviewing EV fire experiments:

- Equivalent or comparable vehicle models should be used in comparative testing of electric and internal combustion engine vehicles to negate/minimise the variations due to design and construction.
- Mock-vehicles and mock-battery packs used in some experiments are not likely to behave in a similar fashion to production vehicles during a fire.
- Critical variables that may produce different results include the ignition/failure method, battery state of charge, battery condition, test enclosure design, and ambient and ventilation conditions.
- The failure of lithium-ion battery cells and thermal runaway can produce highly directional jet-flames depending on battery design and venting. The measurement of total HRR or peak HRR may not capture the potential for vehicle fire spread and damage to building elements when vehicles burn in this manner.
- EV battery fires produce a number of HRR peaks related to the sequential failure of individual battery cells and modules.

- Standard methods for the measurement of HRR in fire testing may not accurately reflect the release of stored energy from LiBs when they burn.
- The nature and volume of vapours and gases produced, and the potential for explosion, need to be quantified in all testing of LiBs and EVs.
- Australia is in the process of establishing national safety standards for electric vehicles that will align with existing international standards. A gap in the standards and regulations that AFAC suggests should be addressed with urgency is regarding the use of second-life EV batteries.

AFAC suggests that the supply of second hand EVs should be tightly regulated and that a compliance regime as a minimum should be developed to ensure the quality and safety of second-life batteries. LiBs contain varying types of chemistry and therefore have various charging profiles to ensure the ongoing stability and state of health of a battery cell. Battery cells with an unidentified chemistry or those that have been unknowingly damaged during its first life provide a risk to both the public and first responders.

There is concern that an unregulated market could lead to the proliferation of batteries with questionable or unknown history and therefore a higher risk to public safety.

AFAC is also concerned that enabling the use of second-life LiBs in 'repurposing' or 'remanufacturing' processes, particularly if left unregulated, could lead to the combination of cells of differing chemistry types and state of health. This would lead to instability within the battery, particularly when charging. There is currently no effective non-destructive process to give an accurate state of health of individual cells in a battery system.

(b) **the risk to workers in the automotive industry and emergency services personnel caused by batteries in electric and hybrid vehicles**

It is the view of AFAC members that the hazards and associated risks posed by LiBs in electric and hybrid vehicles are not well understood by many workers in the automotive industry and other peripheral industries. Electric and hybrid vehicles incorporate a range of safety features designed to ensure the safety of occupants and responders. Unfortunately, emergency services will often encounter electric and hybrid vehicles in situations which are beyond what was designed for the vehicle to safely operate.

The risks to these workers include:

- Electric shock or electrocution from high voltage electricity stored within the vehicle's high voltage battery, electrical components, cabling, connected charging equipment and associated energy storage infrastructure.
- Electric shock or electrocution from stranded electrical energy trapped within high voltage battery packs and capacitive high voltage vehicle components.
- Physical injury from unexpected vehicle movement – EVs are silent at idle and emergency responders have been seriously injured during rescue activities when the accelerator has been inadvertently pressed and the vehicle is still switched on.
- Exposure to hazardous materials from leaked coolant or electrolytes associated with LiBs.

If the EV battery experiences thermal runaway, workers may be exposed to physical injury from:

- Extreme fire behaviour including high intensity, jet-like flames.
- Violent venting of toxic, corrosive, and flammable gases, including high energy projectiles.
- Vapour cloud ignition and explosion particularly in enclosed or covered areas such as in garages or carparks.
- Unexpected secondary failures and ignitions after the initial event.

Additional complexities in the management of EV fires include:

- Managing toxic and flammable vapours particularly in compartments such as garages and carparks, which are positioned under or adjacent to occupied areas, especially in domestic dwellings or residential buildings.
- Containment and recovery of large volumes of contaminated fire water runoff.
- Management of unknown hazardous materials - large amounts of toxic and flammable gases are released when EV batteries undergo thermal runaway. The exact chemical composition of lithium-ion battery cells and electrolytes are not routinely provided by product manufacturers, requiring emergency responders to treat incidents involving LiBs on a worst-case scenario basis.

Post incident management and handling of damaged or defective LiBs can expose workers from all industries involved in inspections and assessments, investigations, recovery, recycling, and waste disposal, etc., to associated risks and hazards. Following any incident where an EV battery has sustained damage or is indicating a fault, there is a risk of ignition hours, days or even weeks following the initial incident. There is not yet a clear and viable process for the management, inspection, or disposal/recycling of damaged LiBs of any size.

One particular challenge is the safe removal of fire impacted EVs from underground or multi-deck parking facilities. Due to the risk of secondary ignition, EVs must be removed in a timely manner to facilitate recovery and reoccupation of buildings. Vehicle recovery operators must be able to access low-height carpark facilities, provide adequate personal protective clothing and equipment for their drivers, and be willing to carry the risk of exposure to secondary ignition and potential damage to their recovery vehicle in providing suitable services.

It is the view of AFAC members that safety training for the automotive industry focusses mainly on electrical safety, specifically how to work around high voltage components and connect/disconnect the high voltage battery but does not appear to include training on awareness of the fire and explosion risks, identifying warning signs of damaged LiBs, safe handling and storage, or actions to take when batteries undergo thermal runaway.

(c) the adequacy of training and equipment for workers in the automotive industry and emergency services personnel regarding potential hazards of batteries in electric and hybrid vehicles

AFAC members have identified a low level of awareness of the sustained risk of thermal runaway in LiBs and the safe handling of damaged EVs and EV batteries, particularly across the automotive industry, emergency services sector, and the waste and recycling industries. There is currently an evident lack of adequate tools, equipment and training for workers in these industries, putting workers at significant risk of injury.

Training emergency responders is a significant challenge as EV incidents may be encountered by police, volunteer rescue agencies, fire services and tow truck operators. It is important that all responders understand the hazards and risks that may be present when dealing with EVs.

To address the knowledge gaps amongst emergency responders and some parts of the automotive industry, several AFAC member agencies have developed awareness packages for their personnel. To assist with this process and to achieve a level of national consistency, AFAC developed the Guideline for Incidents involving Electric Vehicles.

AFAC has recognised a need for further practical training for firefighters when responding to incidents involving EVs. AFAC is in early consultation with the Australian Government's National Electric Vehicle Strategy team to focus the development of any training on responding to the following situations:

- EV battery fires
- EV collisions with occupants trapped
- EV collisions with occupants trapped and vehicle on fire
- EV fires in road tunnels or carparks and other enclosed or covered structures
- Shipboard fires involving EVs
- EV incidents involving connected charging equipment
- Electric truck and electric bus fires
- Fuel cell electric vehicle fires (these vehicles are less common but are powered by LiBs and also incorporate hydrogen gas storage to produce electrical energy within the fuel cell)
- Structure fires where an EV is being used to provide electrical energy to the structure (bidirectional charging)
- Flood-affected EVs.

AFAC members are strongly advocating for fire protection measures that will assist firefighting operations in the event of EV-related fires. Note that these considerations may be readily achievable in new structures, however the implementation of these measures in existing buildings is understandably more challenging. AFAC (with member support including from FRNSW and RFS) has moved to advise government and industry that underground EV parking should be classified as a special hazard that requires builders to consider specific fire protection measures. A greater balance between industry standards and fire protection provisions is required. Some desired measures include:

- Early smoke detection in areas where EVs are parked
- Automatic ventilation in parking areas to remove toxic and flammable vapours, gases and smoke
- Automatic notification to the fire service
- Automatic shutdown of EV charging facilities upon activation of alarm and facility for fire services to isolate EV charging
- Adequate structural stability and compartmentation
- Availability of firefighting water on site
- Automatic fire sprinkler systems in all parking areas to 11inimize fire spread and protect structural building elements

- CCTV including thermal imaging in areas where Evs are parked to assist with situational awareness, firefighting intervention, and subsequent investigations
- Onsite facility to capture and recover contaminated water runoff
- Onsite emergency services information package.

(d) any other related matters.

AFAC has published several guidelines and position statements on LiBs and alternative energy-related matters, including:

- Incidents involving PV array and battery energy storage systems
- Incidents involving Electric Vehicles
- Electric Vehicles (EV) and EV charging equipment in the built environment

AFAC currently facilitates the Alternative and Renewable Energy Technologies (ARET) working group. This working group has been largely responsible for the publication of interim operational advice for dealing with LiB failure to maximise work health and safety for operational firefighters, linked above. The working group are also involved in:

- Collaboration and information sharing between agencies to identify innovation, progress and best practice.
- Advocating for and contributing to improved regulation, codes, and standards to support a safer clean energy transition.

AFAC, through its ARET working group currently supports and liaises regularly with the Fire and Rescue NSW led research program Safety of Alternative and Renewable Energy Technologies (SARET). The research and testing program includes four main projects:

1. Fire service response to lithium-ion battery fires
2. End-of-life lithium-ion battery hazard management
3. Electric vehicle fires in structures
4. Fire propagation in battery energy storage systems

The program aims to inform operational procedures, new equipment and training for firefighters and fire safety requirements for buildings and infrastructure housing these technologies.

The SARET program has some financial support from the Australian Building Codes Board (ABCB) and other sources. It also has a number of industry sponsors providing products for inclusion in the testing program, and other key stakeholders offering in-kind support.

Additional funding is being sought to complete the program and deliver the needs of government for a safer transition to clean energy technologies.

AFAC recognises and supports Australia's transition to sustainable forms of energy. AFAC also implores policy makers to ensure appropriate safety measures are developed, maintained and regulated to reduce the risk to communities and first responders.

APPENDIX 1: AFAC MEMBER ORGANISATIONS

Full Members (33)

Australian Capital Territory
ACT Emergency Services Agency
ACT Parks and Conservation Service

New South Wales
Fire and Rescue NSW
NSW Rural Fire Service
Forestry Corporation of NSW
NSW National Parks and Wildlife Service
NSW State Emergency Service
Surf Life Saving New South Wales

New Zealand
Fire and Emergency New Zealand

Northern Territory
Northern Territory Fire and Rescue Service
Northern Territory Emergency Service
Bushfires NT

Queensland
Queensland Parks and Wildlife Service
Queensland Fire and Emergency Services

South Australia
Department for Environment and Water (National Parks and Wildlife Service)
South Australian Fire and Emergency Services Commission
South Australia Country Fire Service
South Australian Metropolitan Fire Service
South Australian State Emergency Service

Tasmania
Sustainable Timber Tasmania
Parks and Wildlife Service
Tasmania Fire Service
Tasmania State Emergency Service

Victoria
Country Fire Authority
Forest Fire Management, Department of Energy, Environment and Climate Action
Fire Rescue Victoria
Parks Victoria
Victoria State Emergency Service

Western Australia
Department of Fire and Emergency Services

Department of Biodiversity Conservation and Attractions, Parks and Wildlife Service

National
Air Services Australia
Department of Home Affairs, National Emergency Management Agency
Parks Australia

Affiliate members (21)
Ambulance Tasmania
Australasian Road Rescue Organisation
Australian Maritime Safety Authority
Australian Red Cross
Brisbane City Council
Bureau of Meteorology
Council of Australian Volunteer Fire Associations
Department of Conservation Te Papa Atawhai New Zealand
Emergency Management Victoria
Geoscience Australia
Hong Kong Fire Services Department
HQPlantations Pty Ltd
Melbourne Water
Ministry of Civil Defence and Emergency Management
National Biosecurity Response Team
National SES Volunteers Association
NSW Department of Primary Industries
NSW Environment Protection Authority
Pacific Islands Fire & Emergency Services Association
Surf Life Saving Australia
VRA Rescue NSW