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Impact of battery electric vehicles on operation and safety of underground structures and buildings

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Abstract:
Alternative (new) propulsion technologies, including battery-electric vehicles, are becoming more prevalent. Whilst such vehicles remain a small overall proportion of the vehicle fleet, the combination of impacts of Government policy and technological advances in alternative fuels is expected to accelerate their increase in numbers on the road in coming years. BEV vehicles are currently the only ones from the group of NEC vehicles that are available on the market in large numbers and are becoming increasingly important, especially in urban environments.

As a result of these changes, the nature of safety risks (including from fire) is expected to change with time, and detailed consideration of the risk of significant incidents involving such vehicles is required. A focus of the consequences of incidents with such vehicles is put on underground structures and enclosed facilities like road tunnels or garages. This includes the evaluation of incident consequences with particular attention paid to fire characteristics and toxic emissions and their impact on users and on emergency intervention strategies.

Research up to now on BEV concerned mainly fires of individual battery packs, in a view cases full BEV passenger car size but no bigger vehicles like busses or trucks. Based on these tests the following conclusions can be drawn:

- Fire within a BEV could start either from the vehicle itself or the battery pack. If the fire starts in the vehicle, it does not necessarily include the battery pack.
- If an engulfing fire includes the battery pack, there is a time gap between initial car fire and battery ignition, allowing time to escape.
- The peak heat release rate of a car size BEV is slightly higher than that of conventionally fuelled vehicles. The average HRR of a fire is in the same range as that of a conventional car fire. However, how much additional heat is released depends very much on the SOC of the battery.
- In general, smoke toxicity does not differ significantly between ICE and BEV fires, except for hydrogen fluoride.
- Stopping thermal runaway and/or extinguishing battery fires requires large quantities of water. Alternative firefighting methods, like fire lances to inject water directly into the battery casing proved to be very efficient, as the thermal runaway can be stopped, preventing a further spread of fire.
- The drainage water might contain some metals such as nickel and cobalt, and in concentrations high enough to require special treatment.
- PC size BEV fires in tunnels don't pose an additional risk due to the high ventilation rates. However, toxicity might be a problem for fires in enclosed facilities with little air exchange rates, e.g. garages.
- Current building regulations for garages in Austria concern only the installation of charging stations form the electrotechnical point of view. BEV fire smoke management in garages is currently not taken into account. This aspect should be re-evaluated.
- BEV fires of bigger vehicles have been reported (mainly for fires in bus depots), but there is very little research concerning such fires.