What new demands do EV's place on our building regulations?

Introduction

During the past few years, ASG, along with several other specialist companies, have designed and installed hundreds of car park ventilation systems, all compliant with the functional requirements of the current building regulations. Many of these will also have included "engineered design solutions" designed to meet those regulations, both in environmental and smoke control modes. These engineered design solutions will have included enhancement to life safety, environmental control and reduction in energy consumption with corresponding reduction in operating costs.

It is both the engineered systems, and code compliant systems that give cause for concern following the introduction of electrically powered vehicles (EV's), and, indeed, their rapidly increasing numbers.

This report highlights some of the more serious concerns relating especially to the perceived fire hazards associated with EV's, and the lack of available guidance that is necessary to enable those responsible for the design and installation of car park ventilation systems to create a good, evidence based practical system design, that would be compliant with equally evidence based building regulations.

Background

In the first edition of the Advanced Smoke Group publication *Design considerations for the ventilation of open sided and enclosed car parks,* published in 2021, it was argued that more research was needed into the potential hazards associated with electrically powered vehicles, as too little was known of the potential fire load and resultant emissions in the event of fire. Several serious hazards were listed in the publication, not least the risk of thermal runaway and the difficulty of controlling and extinguishing a battery fire on an EV.

Whilst the government has extended the date by which all new vehicles must be electrically powered, it is anticipated that the rate of growth of electrically powered vehicles will continue, and even increase. For this reason, and with the corresponding need to accommodate EV charging points within eclosed and underground car parks, the urgency in quantifying the additional hazards (if any) is extremely high.

The Perceived Hazards

In a 2023 publication prepared by Arup on behalf of the UK government, some fire related hazards and areas of concern where highlighted, but no practical solutions were suggested. For example, the publication acknowledges the fact that there is no established design fire load on which to base ventilation calculations, and that "there is a greater presence of toxic gases in lithium-ion battery fires than in internal combustion engine vehicles". However, the report states that the designers of smoke ventilation systems for car parks should "review if the safety measures are still adequate for EV fires". Surely, building regulations should lay down the guidance necessary to enable the designer to develop a design that is compliant, or at least, make reference to acceptable other authoritative guidance, such as a British Standard, providing necessary information. Without research, how can this be done?

An article has also been prepared for the RICS by Arup. The article focuses on charging points for EV's and highlights some of the principal risks associated with vehicle battery fire are highlighted, and the challenges that such risks pose. The article references guidance in the above publication for the adoption of a fire risk assessment for car park undertaken by a competent fire risk assessor. This is sound guidance, but for a realistic fire risk assessment to be undertaken, it must be done in conjunction with the Fire Strategy for the entire building, and to be realistic, it must be based on sound guidance relating to fire loads, which for car parks accommodating EV's, does not currently exist.

Thermal runaway and reignition are two of the most serious concerns. Bearing in mind that fact that vehicle batteries are usually located in the floor of the vehicle, a realistic and effective means of supressing a battery fire in an EV when located within the limited space of an enclosed car park needs to be considered.

Another concern has been expressed relating to the risks associated with damaged or older faulty batteries on vehicles which may create a greater fire hazard.

Current Guidance

The Building Regulations Approved Document B still states in Section B3 that 10 air changes per hour should be the ventilation rate in the event of fire. The guidance provides no justification for this figure, which was adopted many years ago and would not have envisaged the fire loads from the vehicles of today. Nor is there any consideration given to the multi-storey car parks above and below ground that form part of modern building practices and comprise far more levels than envisaged in current regulations.

The current British Standard for car parks is BS7346: Part 7: 2013 *Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks* which is out of date and long overdue for review.

During the last year, EN/TS 12101-11-2022 was listed by CEN as a Technical Specification (TS), as opposed to a full European Standard (EN) as the document did not meet the necessary criteria to be ratified as a full standard. BSI lists the document on the internet as a standard supported by the FSH/25 committee, even though the document failed to achieve the required level of approval for ratification. When asked for confirmation as to whether or not EN/TS 12101-11 was to replace BS7346: Part 7, we were told that "the BS is under systematic review and the committeewould like to revise it, unless there is a clear scope conflict this will go ahead. Should the [EN] TS be updated to cover the same scope as BS7346: Part 7, then they would both remain available". Until this is done, we have no up to date guidance.

Whilst the research undertaken at BRE in 2010 endorsed the guidance contained in BS7346: Part 7: 2013 for design fire loads, neither the British Standard nor the research and tests undertaken at BRE included battery powered vehicles, indeed they specifically excluded them from their scope.

For "engineered" design solutions for car park ventilation in the event of fire, BS7346: Part 7: 2013, quotes system design fire loads of 4MW for sprinklered car parks or 8MW for unsprinklered installations. However, there is no guidance available to the designers of car park ventilation systems to support the British Standard, or current building regulations, to enable them to design for the presence of electrically powered vehicles within an enclosed car park.

As far as we can establish, there are currently no plans to undertake any further UK based research into the potential fire loads from EV fires, which would be a logical step, as a project supplementary to the work undertaken at BRE in 2010.

Concerns

Discussions between professionals in the fire engineering industry relating to the risks associated with EV's are now common, and publicity has been growing. It is not, therefore, surprising that regulators are justifiably requesting supporting evidence from developers that life safety concerns have been addressed specifically in relation to the and life safety systems supporting EV charging and EV vehicle parking in enclosed and underground car parks, including adequate fire suppression and ventilation systems.

Approaches to HSE, BRE, Local Authority Building Control and the fire service have been made, yet no practical interest has been shown in helping to promote the need for the necessary UK based research.

As mentioned earlier in this report, BS7346: Part 7: 2013 is out of date and should have been reviewed and redrafted 5 years ago. Building regulations are well out of date, with guidance on car park ventilation rates based on vehicles long departed for the scrap heap.

Designers have no practical data on which to base system designs. It is widely reported that Lithium-Ion batteries emit toxic gases, but there is no existing guidance on precisely what these are and in what quantities they may be emitted in the event of fire.

In a recent posting on LinkedIn, Dr Tony Fogarty, Managing Director of RM Risk Management Limited, stated that at a recent seminar, he was asked to explain the process of EV fires, in his response he explained that:

when an electric vehicle's battery pack goes into thermal runaway, it releases toxic and flammable gases that can form a large vapour cloud, primarily in enclosed spaces. This is why it is crucial for emergency responders to be aware of the risks and potential dangers. For every 1 kWh of battery capacity, approximately 700 litres of gases are released. With some newer EV models coming to the market with up to 100 kWh batteries, it's important to understand the potential hazards.

Imagine that gas cloud in a busy multistorey enclosed car park.

And further to all of this, if there is an EV fire, in what way can the spread of such fire be restricted? Also, in the limited space of a car park bay, how can they be extinguished?

Developers and local authorities are being pressed to incorporate EV charging points within fully enclosed multi-level basement car parks, despite the lack of knowledge of the actual hazards.

It is accepted that EV's are unlikely to be any more likely to catch fire than the conventional combustion engine powered vehicle, but what designers need to know is, if an EV does catch fire,

I. what are the consequences
II. will the fire load be greater than those loads currently adopted for a domestic vehicle (BS7346: Part 7: 2013)
III. what will the products of combustion contain
IV. what additional measures, if any, should be taken to limit the vehicle to vehicle spread of the fire
V. what additional measures (if any) need to be accommodated to extinguish the fire

Conclusions

In 2010, BRE published an extremely comprehensive report on the results of government funded research they had they had undertaken into the then current fire hazards of family cars marketed at that time. The concern had been that new materials were being used in the construction of the vehicles of the day which may influence the fire loads and rate of burn.

The conclusion of the BRE report was that the fire loads quoted in the British Standard (BS7346: Part 7) and the Building Regulation guidance at the time was

adequate. However, things have changed significantly since that time with the introduction of EV's.

The construction industry needs research now, in order to identify the real fire risk and determine:

1. A realistic design fire load
2. Is it realistic to continue to apply fixed air change rates as provided in Approved Document B
3. What quantity of toxic gases is emitted by EV batteries in a fire or during charging?
4. A practical means of fire suppression
5. Additional practical safety measures such as the dedicated location of parking bays for EV's, e.g., should they be ground floor level of multistorey car parks.

In addition to the above key needs, what further steps should be taken to consider the additional risks associated with marine applications, such as will be faced on ferries. Before it is too late, this work is needed to ensure public safety.

In the Arup article for RICS mention earlier, RICS global building standards director and fire safety lead Gary Strong is quoted as saying "Car park fires – and the fire risk presented by the increasing take-up expected of EVs and charging points – is a matter on which we are pressing the government for better guidance", this is something we have been pressing for during the past year or more.