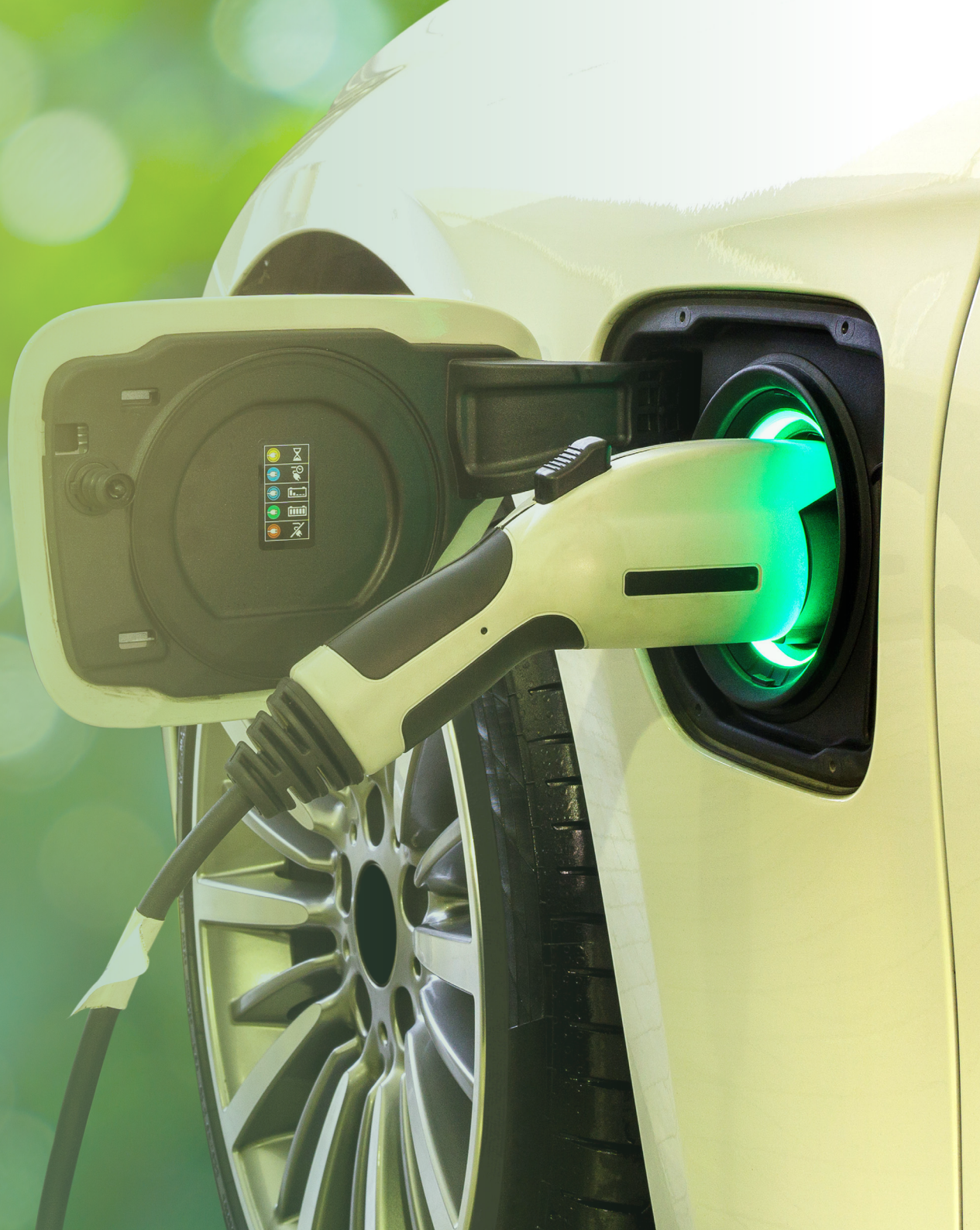
ZURICH
Resilience Solutions

Risk Insight: Electric Vehicle Charging



As Electric Vehicles continue to become more popular in the UK, and as private companies and local authorities strive to reduce their carbon footprints, the demand for a charging infrastructure and dedicated parking areas has exponentially increased. This document provides a brief overview of the main Property and Liability hazards associated with Electric Vehicle charging, and appropriate controls from a loss prevention perspective.

Overview

Significant investment by the UK Government (via the 'Charging Infrastructure Investment Fund'), and by public authorities and private organisations, has resulted in new electric vehicle charging facilities becoming a prominent feature in a wide range of premises from multi-storey car parks, to national parks and commercial/retail premises.

Electric Vehicles (EV), including Hybrid Cars, E-bikes and Mobility Scooters, typically store energy in Lithium batteries of different capacities and chemistries to supply the vehicle's power demand. Recent loss history has shown that fires involving these batteries can create a serious challenge for firefighting.

Many Electric Vehicles use Lithium-Ion batteries (Li-Ions or LIBs) as a power source for the electric motor and other electrical components utilised in modern vehicles. Compared to other, conventional battery types, Lithium batteries provide higher energy densities and extended lifetimes. If the Electric Vehicles are operated according to manufacturer's specifications, operation is safe. However, the hazards increase if normal operating conditions are deviated from such as:

- Age and usage
- Modification of the Lithium batteries and/or configuration of the vehicle
- External damage or impact to Lithium batteries (e.g. accident/impact, mechanical and thermal stress, extreme vibrations, etc.)
- Electrical malfunction during charging and discharging

In the worst-case scenario, the above-mentioned conditions can cause a thermal runaway of the battery cells, which is a highly exothermic reaction creating toxic, flammable, and/or explosive chemical components.

The gaseous components generated, such as hydrogen, carbon monoxide, etc. by the fire, and those created by cooling and extinguishing activities, such as hydrogen fluoride and other toxins, present an increased risk to fire fighters and building occupants, and can contribute to a high degree of environmental contamination and damage in the surrounding area.

Guidance

There are a number of factors that should be considered prior to and following the installation of electric vehicle charging units at your premises to ensure that the associated hazards are adequately managed. The following sections highlight the main areas that should be considered.

Location

Prior to installation a fire risk assessment should be carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) that considers the control measures required when selecting and designing charging/parking areas.

Permanently installed charging units are preferred to mobile charging devices, ideally installed externally, and located as far as possible from important buildings, structures and utilities. The distance required between a charging unit/parking area and buildings, etc. will be primarily driven by the construction of the building walls.

Ideally, electric vehicle charging, and parking should be located at least 10 m from combustible walls or at least 7.5 m from unprotected openings/extensive glazing in non-combustible walls.

Consideration as to what is stored externally will also be needed. Electric charging units/parking areas should not be located within a minimum of 10 metres of external combustible or flammable storage areas, such as waste compounds, pallet storage or gas cylinder cages.

External charging units are exposed to changing weather conditions, and whilst these are designed to withstand a degree of exposure to the elements, the location where stations are installed must be assessed for flood. Flooding can come from a number of sources such as rivers, surface water during heavy rainfall, and inadequate storm drainage. Charging units should not be installed in any location where flood or excessive surface water run-off and pooling is considered a risk.

In circumstances where electric vehicle charging units are installed internally, charging/parking areas should be located as close as possible to exits and preferably on the ground level to allow easy access for the fire brigade. The high combustible fire load of modern cars in general and the high energy generated in these types of fires, can result in a well-developed fire involving numerous vehicles by the time the fire brigade arrives.

Internal charging/parking areas should be in a separate fire compartment with a minimum of 60 minutes fire resistance, subject to consideration of the hazards presented by the occupation of the building. Basement level charging/parking areas present additional complexities for firefighting therefore these compartments should achieve a minimum of 120 minutes fire resistance.

The generation of toxic gases is particularly problematic for firefighting activities in below ground charging areas. It is therefore essential that below ground or concealed charging and parking areas are provided with adequate ventilation.

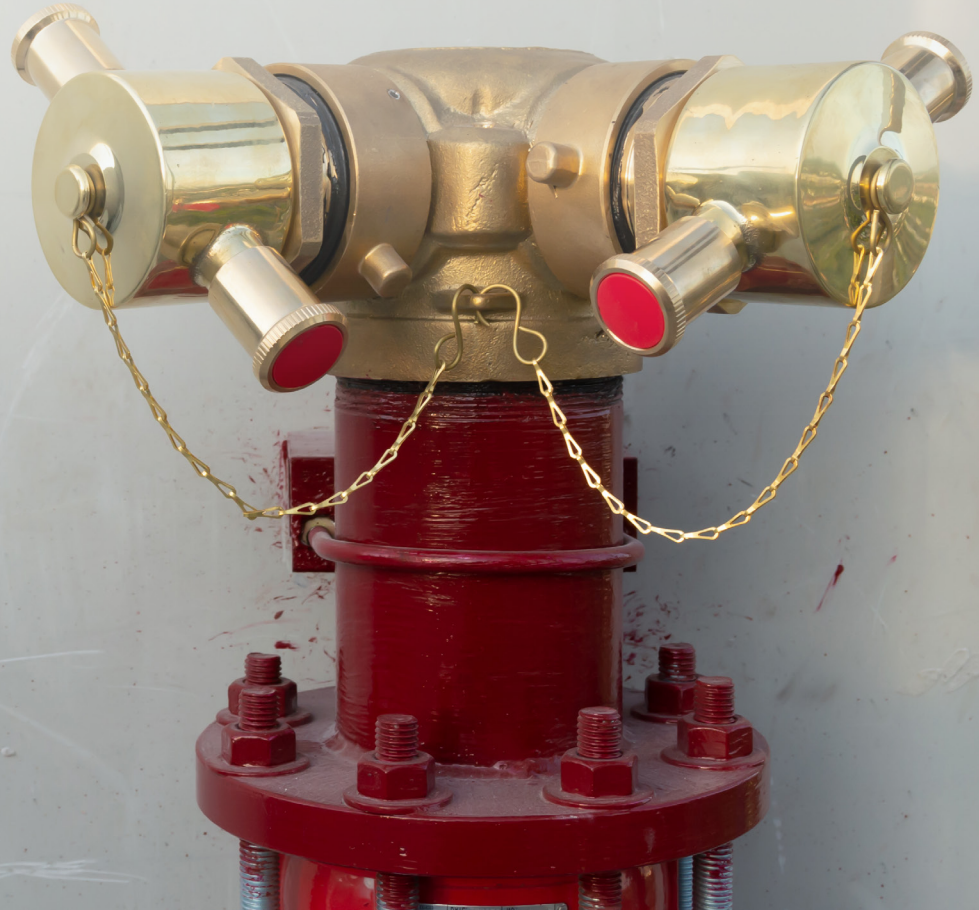
Wall mounted charging units, whether internal or external, should be installed on non-combustible walls and installation beneath or next to unprotected openings/extensive glazing should be avoided.

Fire Detection and Suppression

Internal Electric Vehicle charging and parking areas should be equipped with automatic fire detection. The fire detectors should be installed close to the charging units/Electric Vehicles. Alarms should be automatically transferred to an approved and permanently attended alarm receiving centre.

Installation of sprinkler protection is recommended, particularly in circumstances where chargers are run unattended. The sprinkler system should be designed and installed in accordance with the LPC Sprinkler Rules incorporating BS EN 12845 (ref.31) by engineers having appropriate certification from an independent UKAS accredited third party certification body. If sprinkler protection is already installed, the level of protection should be reviewed with any remedial actions necessary being implemented before charging commences.

Automatic fire detection and sprinkler systems should be interfaced with the power supply for all vehicle chargers to isolate the power automatically in the event of activation.



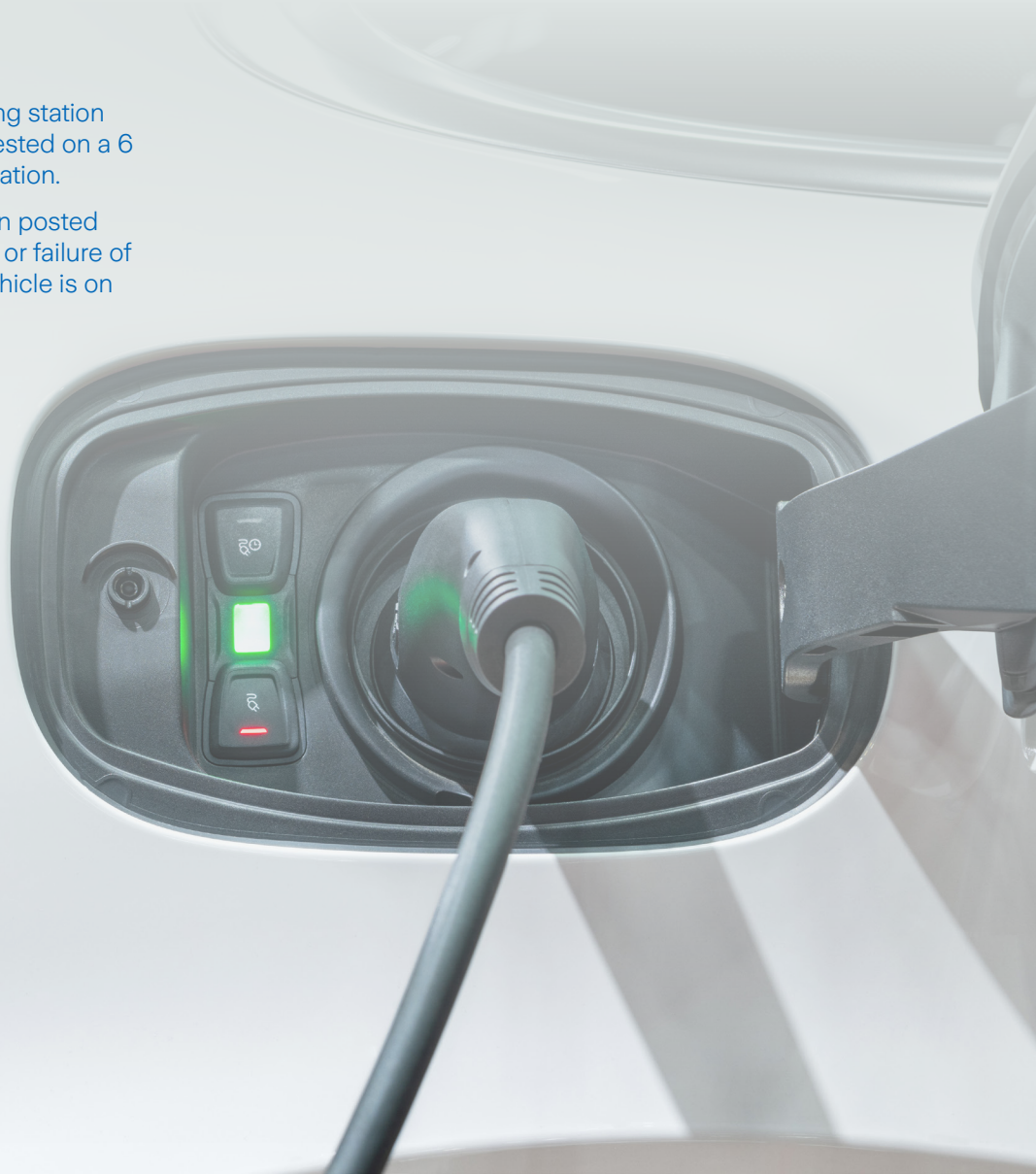
General Controls

In addition to the location of charging/parking areas, and the provision of automatic fire detection and suppression, there are a wide range of general operational controls that require due consideration as part of the overall decision to install charging/parking areas on your premises. These include:

- UK grid connection rules, local planning laws and safety regulations will need to be complied with.
- The presence and operation of charging/parking areas should be integrated into the main fire risk assessment process of the site as a whole.
- Installation – charging units should be installed in accordance with manufacturers guidance and the IET Code of Practice for Electric Charging Equipment Installation.
- Maintenance and Servicing – charging units should be maintained and serviced in accordance with manufacturers recommendations, unless the suggested service programme is superseded by the IET Recommendations. The exception to this being 'Rapid' or 'Fast' Direct Current (DC) charging units which should be maintained and inspected on an annual basis. Planned maintenance and servicing should be accompanied by arrangements for reactive maintenance e.g. user reported unit damage.
- All installation, maintenance and servicing activities should be carried out by suitably certified contractors such as those with NICEIC, ECA, SAFed, NAPIT or SELECT accreditation. If fast DC charging units are installed, these must only be maintained and serviced by contractors who are certified to work with DC equipment.
- A minimum distance of at least 2m around the charging unit and vehicle should be maintained clear of waste, vegetation, storage of stock, and other combustible materials at all times.
- It is recommended charging units are visually inspected on a daily basis, especially when these are openly available for public use. If the charging unit, cables and connectors and/or associated infrastructure is mechanically damaged or electrically deficient, the charging unit should immediately be shut-off and be locked until appropriately repaired.
- Charging/parking areas should clearly be marked with signs. Where rapid DC charging units are provided they should be clearly marked to differentiate them from conventional chargers due to the hazards associated with direct current.
- Adequate spacing between charging/parking areas and access for the fire brigade should be provided in case of a fire.
- Designated cable holders (reels) should be provided near the charging unit to prevent unnecessary tension and subsequent damage/wear and tear.
- Charging unit should be protected with impact protection which is suitably positioned to prevent accidental contact with parking vehicles.
- Where there is open public access to the charging stations, consider whether additional physical protection against malicious damage and vandalism is needed.
- It is important local site staff are provided with suitable training highlighting the increased hazards of DC equipment (if applicable), how to operate the equipment, requirements for day to day visual inspections, how to isolate the charging units and emergency procedures for shut down.
- Vehicle charging should be avoided when the site is unattended for example overnight or at weekends
- Appropriate fire extinguishing appliances should be provided in close proximity to charging parking areas.

Electrical Installation and Distribution

- A residual current device (RCD), should be provided to automatically separate the charging station from the electrical power supply in case of a ground fault. It is recommended these are tested on a 6 monthly basis as per IET Code of Practice for Electric Vehicle Charging Equipment Installation.
- Emergency manual isolation of charging stations should be provided in a prominently sign posted and easily accessible location to allow safe shutdown of equipment in the event of a fault or failure of equipment. When choosing a location consider whether this will remain accessible if a vehicle is on fire.
- In case of an electrical malfunction, the charging station should be automatically disconnected from the electrical supply.



Solar Car Parks

Installation of photovoltaic (PV) solar systems as part of an integrated EV charging system across surface and multi-storey car parks is becoming increasingly common, however the installation of PV panel arrays introduces additional fire and liability hazards to the site that must be understood, and controls put in place to manage those hazards.

There are a variety of different PV panel/roof canopy designs, with the more traditional systems involving mounting (often as a retrofit project) the PV panels onto conventional roof structures such as profiled metal sheeting. There is also now increasing use of PV glazing systems which involves replacing the traditional roof covering with PV panels such that the panels form both the roof and the PV system. This can be achieved with specially designed mounting and sealing solutions that ensure water tightness and structural strength.

More detailed guidance on the fire and other safety considerations for PV solar systems is provided in our separate Risk Topic Photovoltaic Panels and Systems Design, Installation and Maintenance. In addition to the controls suggested within that guidance, there are additional considerations relating specifically to the addition of PV solar panels to surface or multi-storey car parks, including:

- Roof Canopy Construction – to reduce the risk of fire spread the use of non-combustible materials should be used. Specifically, the use of combustible decorative linings/cladding is to be avoided as these can aid rapid fire spread.
- Impact Damage Potential – roof stanchions/supports of the roof canopy should be built to with stand vehicle impact or be provided with suitable impact protection in addition to the charging unit as previously stated.
- Surface Water Drainage – consideration should be given for adequate drainage provision for the surface water running off the PV panel canopy roof areas to ensure this does not potentially cause additional risks such as slip hazards etc. during winter conditions.
- DC Cables/Inverters – PV panels generate DC current which is higher risk and therefore this additional risk must be managed, particularly in public spaces. DC cables from the panels should be concealed in integrated cable trays, and invertor panels should ideally be sited in a dedicated electrical room/building which is secured. Adequate warning signage should be provided highlighting the risks of DC electrical equipment.
- Automatic Fire Alarm/Sprinkler Systems – where automatic fire alarm protection and/or sprinklers systems have been provided, these should be extended to provide protection underneath the PV solar panel roof canopy structure.
- Inspections and Maintenance – PV panels should be adequately maintained and inspected in accordance with manufacturer's recommendations. It is important that panels are inspected regularly to identify damage, kept clean and clear of litter, nesting materials and other debris which can increase the risk of fire spread. Regular servicing/maintenance should only be caried out by electricians suitably qualified under NICEIC, ECA, SAFed, NAPIT or SELECT for DC installations.
- Staff Training/Instruction – Local site staff should be fully trained on requirements for day to day visual inspections, general maintenance/cleaning of PV panels, and emergency shut down including the location of the emergency isolation switch.
- Security – Consideration needs to be given for the provision of adequate security protections of the site as the PV solar panels are likely to be more easily accessible and are potentially at higher risk from malicious damage and theft.

Some of these integrated PV solar and EV charging systems can also incorporate Energy Storage Systems such as battery storage facilities. Again it is important that the additional fire risks associated with Energy Storage Systems are also fully understood and careful consideration is given to the installation of these types of systems. For further guidance on this topic please refer to your local Zurich Risk Engineer.

E-Bikes and Mobility Scooters

As previously stated, E-Bikes and Mobility Scooters can also operate on the same Lithium batteries as any other Electric Vehicle. Whilst these machines may be smaller and charged using different types of equipment, there is still a risk of a thermal runaway fire and as such, in addition to the location and operational controls previously covered, due consideration for controls specific to this type of charging is needed.

Both E-Bikes and Mobility Scooters have options to charge the battery whilst in situ, or the battery can be removed and charged independently in a separate location. As popularity for E-bikes has grown, so has the demand for charging facilities for employees and site visitors. As a minimum, the following control measures should be considered:

- Designated charging areas for E-Bikes should be provided, preferably outside buildings and in line with the spatial separation previously set out.
- Designated charging areas for Mobility Scooters and E-Bikes must not obstruct fire exit routes - this is particularly important where batteries are being charged in situ and there will be an accumulation of machines.
- Only charging equipment supplied by the manufacture of the machine should be used to charge the battery. All charging equipment should be CE marked, and manufactured for the UK electrical supply – the use of voltage convertor adaptors should not be permitted.
- All charging equipment utilised on your premises, whether it belongs to the organisation or individual employees, should be included within a documented Portable Appliance Testing Programme.
- Unattended charging, particularly in residential buildings, should not be permitted.
- The use of multi-point adaptors should not be used for charging purposes. Additional sockets should be provided if current provisions in the charging area are not sufficient.

Should the demand for this type of charging facilities be significant, consideration should be given to the provision of charging cabinets with individual lockable boxes constructed of metal or with fire resistance, and each with its own electrical connection.

Liability Considerations

The increase in demand both to provide and use electric vehicle charging units, also presents an increased liability risk to business and organisations. This means from a liability perspective, a risk-based approach to asset management is essential.

In addition to the property controls already discussed, many of which also contribute to managing the liability exposure, the following should be considered as 'best practice' when it comes to liability risk mitigation for providers of electric charging units:

- Accessibility – It is important that the design of the electric vehicle charging units and associated parking areas comply with the Equality Act 2010, Disability Discrimination Act (DDA) 1995 guidelines and Department for Transport (DfT) Inclusive Mobility – a guide on best practice on access to pedestrian and transport infrastructure (May 2002) guidelines.
- Appropriate signage – Appropriate signage with suitable and sufficient information and instructions on usage which mitigates risk of injury and property damage, emergency procedures (including emergency contact details) and general user safety etiquette e.g. prohibition of smoking (Terms of Use Agreement) should be provided.
- Environment – Appropriate safety measures for all user profiles should be considered. Considerations should be made on lighting, noise, ventilation, charging bay space, height of the charging unit and general housekeeping e.g. removal of combustible materials.

In addition to your responsibilities as the operator of the charging equipment, the user (i.e. employee or site visitor) will also owe a duty of care to other road users including pedestrians. The following should be considered as 'best practice' when it comes to liability risk mitigation for electric vehicle charging unit users:

- Physical conditions – Before and after charging, users should visually inspect charging cables for any damage (including wear and tear and/or vandalism) which may expose live copper wiring.
- Slips/Trips/Falls – When the charging cable is plugged into the charging unit, users should refrain from overtly stretching the cable and/or trailing the cable across pedestrian walkways or access points. The distance between the vehicle charging unit and the vehicle should be kept to a minimal and trailing cables covered using a safety protection mat/cover where necessary (the cable should be of sufficiently bright and different colour to the footpath so as to make it clear and obvious to users of the footpath).
- Reporting - Users have a responsibility to report any visual damage on the charging unit itself and subsequently refrain from using the unit. Reporting procedures/instructions should be clearly displayed at the charging area.

Further information regarding the liability risks associated with Electric Vehicles is provided in our Risk Topic 'Electric Vehicles'.

Conclusion

Recent fires involving modern cars have shown that these pose a significant challenge to the fire brigade due to the high combustible fire load of materials used in their manufacture, and speed with which the fire can spread between vehicles.

Fires involving Lithium-Ion batteries, such as those present in Electric Vehicles, have shown that defective batteries can create severe fires with high temperatures and exothermic reactions, creating significant challenges for fire fighting.

Together these two factors create an increased fire risk to your premises which if not adequately controlled, could lead to significant loss of property and income. Appropriate separation/compartmentation, early detection, and implementation of good operational controls such as regular inspection and maintenance, staff training, and effective signage are key to manage and mitigate the property and liability risks associated with the provision of Electric Vehicle charging and parking.

Zurich Resilience Solutions

For further information about any of the topics mentioned in this guidance, or to discuss a specific Electric Vehicle charging installation project, please speak to your local Zurich contact, or email Zurich Resilience Solutions at zrs.property.uk@uk.zurich.com.

Chartered Insurers

We are Chartered Insurers, publicly committed to a customer-first approach and values that align with a professional Code of Ethics. We'll provide solutions relevant to your needs, maintaining our knowledge through qualifications and ongoing professional development.

CONTACT
Risk Engineering UK
Risk Support Services
6th Floor, The Colmore Building
20 Colmore Circus, Queensway
Birmingham
B4 6AT

For further information about any of the topics mentioned in this document please speak to your local Zurich contact, or email Zurich Resilience Solutions at zrs.enquiries@uk.zurich.com or alternatively call this number +44 (0) 121 697 9131

For more information please visit: www.zurich.com/riskengineering

Zurich Management Services Limited, Registered in England and Wales no. 2741053,
Registered Office: The Zurich Centre, 3000 Parkway, Whiteley, Fareham, Hampshire PO15 7JZ

ZRSTM58 (12/21) ZUR

References

1. VdS 3471:2021-02 (01). Ladestationen für Elektrostraßenfahrzeuge. Cologne, Germany; VdS Schadenverhütung GmbH. 2021.
2. VdS 3885:2020-12 (01). Elektrofahrzeuge in geschlossenen Garagen. Cologne, Germany; VdS Schadenverhütung GmbH. 2020.
3. EN IEC 61851-1: Electric vehicle conductive charging system2019-12 print
4. EN ISO 15118-1: Road vehicles - Vehicle to grid communication interface 2019-08 Print
5. Dr. Michael Buser. Lithium Batterie Fires https://www.brand-feuer.de/index.php/Lithium_Batterien
6. NFPA Research Foundation; Modern Vehicle Fire Hazards in Parking Garages and Vehicle Carriers, MA USA April 2020
7. Fire Protection Authority RISCAuthority RC59: Recommendations for fire safety when charging electric vehicles.
8. 4th Edition IET Code of Practice for Electric Vehicle Charging Equipment Installation
9. Relevant UK national fire safety regulations e.g.
    - The Regulatory Reform (Fire Safety) Order 2005,
    - The Fire (Scotland) Act 2005,
    - Fire Safety (Scotland) Regulations 2006,
    - Fire and Rescue Services (Northern Ireland) Order 2006
    - Fire Safety Regulations (Northern Ireland) 2010