Loss Prevention Standards – Asset Classes

Electric and Hybrid Vehicle Charging

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This Loss Prevention Standard discusses the main risks posed by electric vehicles to buildings and other valuable assets and provides useful guidance to help reduce the risks of loss or damage.

AVIVA

Electric and Hybrid Vehicle Charging

Introduction

Driven by the need for lower emissions, better fuel economy and higher efficiency, electric and hybrid vehicles are growing in popularity and are a common sight on the road network. They will become more common throughout construction sites and wider commercial activities.

Electric vehicles (EVs) can come in many shapes and sizes such as motorbikes, cars and mobile plant/equipment. The range of vehicles and their usage continues to expand as internal combustion engines are used less, and technological and design advances are made.

This Loss Prevention Standard focuses primarily on charging motorbikes, cars and mobile plant, but exposure of battery charging to smaller items (scooters and pedal cycles) should also be borne in mind when assessing exposure to property or other assets.

There are different types of EVs available, including:

- **Battery electric vehicle (BEV*)** - powered solely by a rechargeable battery and incorporates regenerative braking which helps to extend the available range
- **Hybrid electric vehicle (HEV*) -** driven by both an electric motor and an internal combustion engine (ICE), with the ability to recharge the battery whilst in motion
- **Mild electric hybrid (MHEV*)** - features a small battery pack with an integrated starter-generator, which is designed to improve efficiency and to deliver a tiny boost in acceleration
- **Plug-in hybrid electric vehicle (PHEV*)** - like a HEV although having a much larger battery with an extended range and can be charged via the electricity network
- **Hydrogen fuel cell electric vehicle (FCEV*)** - operates by taking hydrogen fuel and reacting it with oxygen to produce electricity. They produce zero CO^2 and air pollutant tailpipe emissions as water is the only waste product

  **all of the above are referenced throughout this document as EVs*

In most cases, a high voltage lithium-Ion battery is used to store electrical energy. The use of this technology continues to evolve as do the hazards associated with it. These hazards include potential damage to property, infrastructure and risk to life. EVs and their charging infrastructure present both an ignition source and a large fire load. A fire involving these arrangements can be severe, fast spreading and very smoky.

This document looks specifically at the risks posed by EVs to your property.

For specific risk management guidance relating to electric and hybrid vehicles and your motor fleet, please see our Loss Prevention Standard entitled **Electric and Hybrid Vehicle Awareness**.

Understanding the Risks

All batteries, whether on charge, in use or idle, are energy storage devices with the potential to dramatically release that stored energy as fire or an explosion. This can happen at any time, for a number of reasons and without warning. In order to protect your property, it is essential therefore that this risk is understood, assessed, mitigated and prepared for.

One of the most common causes of battery fire and explosion is thermal runaway, which occurs when the amount of heat generated inside the battery is greater than the heat being dissipated. If this is not corrected (e.g., if there is a fault on the Battery Management System (BMS), damage to the battery, overcharge, etc.), the rate of increase can become exponential, and pressure builds in the battery cell. Once initiated, thermal runaway cannot be stopped and often results in dramatic fire and/or explosion events. Even relatively small lithium-ion cells, such as those found in hoverboards and vaping devices can cause a significant fire and depending on what this fire exposes, sizeable damage.

Fires involving lithium-ion batteries develop rapidly, often without warning and are notoriously difficult to extinguish.

Lithium-ion batteries contain a cocktail of chemicals. If the battery overheats as a result of an impact or fault, gas including hydrogen, methane and oxygen may be produced and cause the battery to rupture. This releases the evolved gas, which can then ignite, if it comes into contact with an ignition source, or exacerbate an existing fire situation.

It should also be understood that following a vehicle impact or damage, whilst there may be no visible damage to the battery itself, there may be damage to its sensitive internal structure. Over time, this may result in thermal runaway, fire or release of flammable substances from the battery. Fires involving vehicle batteries have been known to occur hours or days after an incident has occurred. Fires have also occurred in the battery when they have been removed to be worked on at workshops. It is critical that the vehicle and battery are thoroughly inspected by a competent engineer following any collision or accident. This could include the use of thermographic means to assess the temperature profile of the batteries.

Other risks include:

- The potential for the electrical systems on the vehicle to affect medical devices such as pacemakers
- The presence of high voltage components and cabling capable of delivering a fatal electric shock
- Components that may retain a dangerous voltage even when a vehicle is switched-off or when the battery is removed from the vehicle, such as for maintenance activities
- Electric motors or the vehicle itself that may move unexpectedly due to magnetic forces within the motors
- Slips, trips & falls risks associated with trailing charging cables
- Theft of the cabling or charging equipment
- The quality and arrangements of the charging equipment not being fit for purpose

Charging

One certainty of owning an EV is that it will need frequent charging. There are a number of important considerations when it comes to arrangements for the siting of chargers and the charging activity itself. Whilst there are many reasons why a battery may go into thermal runaway, catch fire or develop fault, charging is one of the most hazardous periods for an EV battery. Fortunately, there are a number of precautions which will reduce the risk of any damage to the battery and/or faults developing.

External Charging

Wherever possible, chargers should be located outside and if practical at least 10 metres from buildings and critical infrastructure. Consider the location of transformers and external plant; combustible yard storage and waste; sprinkler tanks and fire pump house; flammable liquid or gas stores, cages and tanks; foliage growth, etc.– anything that is combustible and/or business critical or that could exacerbate a fire should an incident occur. The aim should be to ensure a fire at a charger or vehicle cannot and does not spread towards or within any exposed assets. However, it is recognised that it can be impractical to position chargers at a significant distance from a building, and so in these instances consider the following:

- Confirm the fire rating of the exposing walls and if necessary, look to increase fire rating or otherwise protect it from fire with a passive structural barrier. A minimum of 1 hour fire resistance is recommended
- Confirm the nature of the building construction and the type of any insulation material
    - Building construction and insulation has varying degrees of combustibility, so it is important to be aware of the nature of the surrounding buildings
    - Where combustible construction exists, it should be identified and either changed for a non-combustible alternative or otherwise protected against fire spread, e.g. coatings or fire suppression
    - Also consider combustible facades, facia's, guttering, etc.
- Look for service penetrations and ensure they are adequately fire stopped using approved products that are fit for purpose (**Note**: Expanding foam is unlikely to be appropriate in the majority of circumstances). Fire rating should be at least commensurate with the surface/structure. Fire stopping should be completed by a competent third party contractor
- Consider what is on the inside of the wall
    - Are there combustible, hazardous or flammable materials stored immediately adjacent to the wall?
    - Is there critical machinery, plant or production?
    - Is the exposure important?
    - Sprinkler valves?
    - Offices?
- Consider if external wall mounted water drenchers are needed to protect the exposure

Also consider:

- Where chargers are being considered for multi storey car parks, they should be installed on the open air roof deck rather than within the lower levels of the structure
    - **Note**: Some territories do not permit EV charging in basements, in multi storey car parks and below residential blocks. This needs to be thoroughly understood
- Security - ensure that access to chargers, cables and charging infrastructure is secured against illicit use and malicious damage
    - Think about physical perimeter protection, isolation, removal of cables, CCTV and whether there is adequate lighting in the area
    - Think about if this change also changes the security exposure to the site

These and other site-specific considerations should all be taken into account when planning to install EV chargers. It is important to consider all possible outcomes and what impact a major fire in that area might have on the site and your wider business or premises.

Internal Charging

Internal installation of chargers is not recommended by Aviva, and where possible, all charging of EV should be external.

However, due to the expansion in usage and need to provide charging facilities, internal charging is expected to become increasingly common, particularly in car parks and basements of offices and apartment blocks in busy city centres. This exposure presents a number of challenges for property protection.
The fire rating of the structure in the charging area should be confirmed, as should the presence of any combustible elements of construction. These are enclosed areas, where space is often at a premium and limiting the opportunity for spatial separation, furthermore a fire in these enclosed areas will be contained and is likely to become intense. At the construction stage of a new project, a minimum fire rating of 120 minutes should apply to all structural elements in these areas including any ceilings or intermediate floors. This should include fire stopping all service penetrations with material of commensurate fire rating and the installation of fire dampers on ducting – the fire rating of any structure is only as good as its weakest part.

Where charging units are retrofitted into an existing building, the fire resistant rating of the existing construction and structure should be confirmed. If this does not achieve a 120 minute fire resistance rating, then then this should be enhanced.

Where internal charging exposes other occupancies, then the internal fire compartmentation strategy should be assessed and as above, a 120 minute fire resistance rating should be achieved.

Because of the nature of such a fire, there should also be an adequate means of appropriately rated ventilation to allow smoke and heat to effectively dissipate and be exhausted from the enclosed space.

Automatic sprinkler protection continues to be one of the most effective ways of limiting the development and impact of fire. Installing EV chargers could be a significant change to the risk profile and in the first instance you should engage with your sprinkler contractor and insurance broker/company at the earliest possible opportunity. This will ensure that any changes in sprinkler design can be considered, agreed, costed and implemented.

If the existing building does not already benefit from sprinkler protection, then a discussion with your insurers will be necessary. Any change in exposure warrants additional consideration and appropriate levels of protection.

Note: Aviva does not recommend the use of water mist systems for the structural fire suppression of battery charging systems.

Automatic fire detection can also play an important role, in that if a fire does start to develop the alarm can be raised at the earliest stages of the fire, the building can be safely evacuated and the public fire rescue services contacted for manual firefighting. A system complying with Category P1 of BS 5839-1 ensures coverage throughout the building and it is essential that this includes the area where the isolator switch is located.

Note: The consideration here is twofold:

- A fire at the EV and charger exposing the existing building/occupancy or
- A small fire in the existing building/occupancy growing quickly because the fire spreads to the higher hazard EV charging area

Electrical Hazards

Whether internal or external, there is one common hazard – electricity. Fortunately, we are familiar with the risks posed by electrical installations and many of the same principles apply.

Overloading existing electrical installations can result in frequent interruptions, fault, damage and fire. A site survey of the electrical capacity and demand should be completed to determine the number and type of charge points that can be installed. Once the load details are known, then the type and number of chargers can be calculated.

- Chargers should be installed and maintained in accordance with manufacturer's instructions and by a competent electrician (such as those with current NICEIC, ECA, NAPIT accreditation)
    - More information can be found in the Aviva Loss Prevention Standard *Electrical Inspections – Inspection and Testing*
- Regular infra-red thermographic inspections can help identify emerging faults. These inspections should incorporate isolator switches, the local electrical supply network as well as charging infrastructure
    - Further information can be found in the Aviva Loss Prevention Standard *Thermographic Surveys*
- Chargers should be located so that charging cables do not become overstretched
- The circuit supplying the EV charger should be checked to ensure it has capacity for the additional electrical load. Ideally there should be provision of an independent dedicated circuit, protected by its own RCD and easy to isolate
- If a charger becomes faulty, it must be isolated and electrically isolated (locked-off) immediately
    - Suitable warning signs should be provided
- Electrical isolations should be clearly understood and labelled and readily accessible
- Where possible, all chargers should be interlocked with the actuation of the fire alarm, automatic fire detection or sprinkler system
- Routing of cabling should be carefully considered, particularly if multiple cables are running through cable trays, as current draw may cause heating within trays or conduits
- Surge protection safety devices and lightning protection should be installed and regularly tested
- Aviva discourages the use of 3 pin plugs and 13 amp sockets for the charging of EVs, only proprietary charging systems should be used
- Regular visual checks should be undertaken to ensure charging cables and connectors are not damaged or otherwise showing signs of wear

Note: If the EV charging provision includes forms of electrical generation or electric storage, then this entire infrastructure needs to be risk assessed, etc., e.g., solar array, battery energy storage systems. If this is proposed, then please discuss with your insurer and broker.

Note: This document does not include the potential for EVs to become an energy source or export energy to the National Grid. If this is proposed or employed then this should be discussed with your insurer and broker as there are other risk management measures that need to be considered, including appropriate safety relays.

General Considerations

Whether installing chargers inside or outside your property, there are a number of general considerations to assess:

- Managing Change is central to the effectiveness of risk management. Changes to buildings, services, plant, machinery, storage, protection systems, supply chains, business activities, maintenance budgets, or key personnel could alter the risks that threaten your business – the installation of EV chargers is no exception. This change should be thoroughly reviewed – see the Aviva Loss Prevention Standard *Managing Change*
- Any regulatory or other risk assessments (such as fire risk assessments) should be reviewed and revisited
- Upon installation, a thorough check should be completed of the newly installed charger, including:
    - Quality of installation
    - Electrical connections
    - Weather tightness (if external), etc.
- The number of charging bays now, but also for the future should be considered
- As well as allowing for vehicle manoeuvre and parking, charging bays should be spaced and arranged to minimise the impact of fire spreading from one to another
    - The distance between vehicles charging should be as large as possible
- Charging bays should be conspicuously marked, with adequate signage in place. Consider including a contact number for people to report damage or other issues with charging infrastructure
- Charging infrastructure should be protected from impact damage by barriers, kerbs, bollards or similar.
- The charging area should be kept entirely clear of any combustible materials and not located near combustible waste, pump houses, other critical infrastructure such as transformers, electrical panels, gas cylinder or hazardous material stores, etc.
- An emergency manual isolation switch should be provided in a safe and readily accessible location
    - Also ensure there is adequate signage to direct people to it
    - The isolator switch should not be mounted onto a combustible insulated panel. Where there is no alternative, fire resisting board with at least 1 hour fire rating should be installed, extending at least 1 metre radially from the isolator switch
    - Combustible materials should be maintained at a distance of at least 2 metres from the isolator switch. The area underneath the switch should be kept entirely clear of any combustible materials at all times
- As with any high hazard process, interlocking with the fire alarm is an effective means of automatically isolating the charging units. Therefore, as part of any fire alarm strategy, regardless of the location of the charging units, they should be de-energised at the isolator switch upon a fire alarm activation
- Provide a ‘quarantine’ area for vehicles which are suspected to have a damaged or faulty battery
    - Remember, a damaged battery can take several hours to go into thermal runaway and so it is important this is located at a good distance from the building, other infrastructure, vehicles and people. Where the battery is suspected to be damaged or is faulty, the servicing provider should be contacted at the earliest opportunity
- Complete regular visual inspections of charging areas, look for damage, rust, impact, combustible waste or detritus accumulation, signs of vandalism, signage and markings are still in place and conspicuous, etc.
- Fire Brigade - Be sure to maintain suitable access for the Fire and Rescue Service and consider the distance to the nearest source of fire water or hydrant
    - Fire water – it is good practice to understand what fire water is available with pressure and flow tests. The addition of battery charging facilities may require more water in a fire
- When lithium-ion batteries on fire are suppressed with water, they will produce amongst other by-products, lithium hydroxide and hydrogen
    - Consider fire water run-off and containment to protect the environment/contamination
    - Consider the generation of hydrogen and any potential exacerbation of the fire

- Heavy rain and flood – the location of EV charging externally should be considered in relation to the potential for heavy rain accumulations (surface water) or flooding. If exposed and where required, attention should be paid to local drainage and flood defences
    - Where the EV charging facility is a commercial venture, the business impact from flood or denial of access for whatever reason should be considered
- Site topography should also be considered in relation to the provision of EV charging – consider all seasons of the year; the nature of the site at its busiest time of the year; the nature of the site and its geography (e.g., ground slope), etc.
- Consider the impact on any neighbouring properties or adjacent assets that expose your site
    - Similarly, if neighbours start to install EV charging units, consider the exposure this creates
- Consider the implications of such a fire and the smoke generated versus the location of any building air intakes and smoke contamination of a building
- Review and update Business Continuity and Emergency Response Plans. Some questions to ask might be:
    - What contingency plans are in place in case chargers are out of service for a prolonged period of time?
    - What impact on the site's fire strategy does the installation of EV chargers have?
    - What is the impact on site access/egress in the event of a fire involving an EV, etc.?

Checklist

A generic **Electric and Hybrid Vehicle Charging Checklist** is presented in Appendix 1 which can be tailored to your own organisation.

Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services at preferential rates via our network of Specialist Partners, including:

- Electrical inspections and thermographic imaging: Bureau Veritas
- Thermographic imaging and PAT testing: PASS
- Automatic fire detection and portable extinguishers: SECOM
- Security marking: Selectamark
- Business continuity: Horizonscan

For more information please visit:

Aviva Risk Management Solutions – Specialist Partners

Sources and Useful Links

- RC59: Recommendations for Fire Safety When Charging Electric Vehicles – RISCAuthority
- Energy Saving Trust
- The Institution of Engineering and Technology (IET) Code of Practice for Electric Vehicle Charging Equipment Installation - 4th Edition

Additional Information

Relevant Loss Prevention Standards include:

- **Electric and Hybrid Vehicle Awareness**
- **Implementing Electric Vehicles**
- **Business Continuity**
- **Contamination Following a Fire**
- **Control and Management of Combustible Waste Materials**
- **Electrical Installations – Inspection and Testing**
- **Emergency Response Teams**
- **External and Internal Third Party Exposures – Property Protection**
- **External Building Areas – Usage and Safety**
- **External Wall Insulation Systems**
- **Fire Compartmentation**
- **Fire Safety Inspections**
- **Fire Safety Legislation**
- **Heat and Smoke Venting Systems**
- **Housekeeping – Fire Prevention**
- **Managing Change – Property**
- **Managing Contractors**
- **Smoke Contamination**
- **Thermographic Surveys**

To find out more, please visit Aviva Risk Management Solutions or speak to one of our advisors.

Email us at riskadvice@aviva.com or call 0345 366 6666.*

*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.

Appendix 1 – Electric and Hybrid Vehicle Charging Checklist

Location	
Date	
Completed by (name and signature)	

	General Considerations	Y/N	Comments
1.	Is there a formal Management of Change procedure in place which includes the installation of EV chargers?		
2.	Has the Management of Change procedure been followed?		
3.	Have all risk assessments, including the fire risk assessment been reviewed, updated and communicated to take into account the installation of EV chargers?		
4.	Do the number of chargers proposed take into account potential future need?		
5.	Do charging bays have the maximum possible spacing between them?		
6.	Are charging bays clearly marked?		
7.	Do charging bays have adequate lighting?		
8.	Does CCTV provide good coverage across the charging area?		
9.	Have barriers/kerbs/posts been installed to protect the chargers?		
10.	Are chargers located at least 10 metres from combustible materials and critical infrastructure such as external plant, sub-stations, transformers, hazardous goods stores and neighbouring occupancies?		

	General Considerations Contd.	Y/N	Comments
11.	Have chargers been installed so that charging cables are not overstretched?		
12.	Has a competent electrical contractor checked the supply and confirmed there is adequate capacity for the additional electrical load?		
13.	Does the electrical contractor undertaking the installation hold NICEIC, NAPIT, ECA or SELECT (Scotland only) accreditation?		
14.	Is the installation being completed in accordance with the IET Code of Practice for EV Charging Equipment Installation (latest edition)?		
15.	Is there an up to date periodic electrical installation safety inspection report for the installation which will supply the chargers (as per recommendations contained within BS 7671:2018)?		
16.	Will critical parts of the electrical installation and charging infrastructure be subject to annual infra-red thermographic inspections completed by a competent person?		
17.	Are charging cables and infrastructure regularly checked for wear and tear, damage, corrosion, etc?		
18.	Is there an accessible manual emergency isolation switch and is it clearly marked?		
19.	Are the charging units interlocked to de-energise if there is an activation of the fire alarm/sprinkler system?		
20.	Have surge protection devices been installed?		
21.	Are 3 pin plugs / 13 amp sockets being used for charging? **Note**: Aviva discourages the use of 3 pin plugs / 13 amp sockets for the charging of EV, only proprietary charging systems should be used.		

	General Considerations Contd.	Y/N	Comments

22.	Has a safe quarantine area been established for vehicles/batteries which are suspected to have been damaged?		
23.	Has adequate signage been provided clearly identifying the charging bays, electrical installation, hazards and including emergency contact details to report any issues?		
24.	Are all charging areas maintained clear of all combustible materials, detritus, litter, rubbish, foliage, etc. and any other material that may be combustible? Is this checked regularly?		
25.	Have the local Fire and Rescue Service been advised that charging bays have been installed?		
26.	Have the local Fire and Rescue Service been invited to site for a familiarisation visit?		
27.	Is there adequate safe access for the Fire and Rescue Service?		
28.	Has the location of the nearest hydrant or fire-fighting water supply been identified, documented and confirmed as adequately sized?		
29.	Has fire-fighting water run-off and containment of contaminated water been considered in the location of the chargers?		
30.	Is there a process in place to ensure that chargers are isolated and locked-off if they develop a fault?		
31.	Is there a regime of inspection, servicing and maintenance in place in accordance with the manufacturer's instructions and electrical safety guidance?		
32.	Has a regular documented programme of inspection has been established to check for damage, loose combustibles/detritus, vandalism, rust other adverse conditions?		

	General Considerations Contd.	Y/N	Comments
33.	Have EV users and relevant employees been provided with the necessary safety information and training?		
34.	Has the relevant insurance broker/company been advised that EV battery chargers will be/have been installed at your property and relevant cover has been updated/added?		
35.	Have Business Continuity and Emergency Plans been reviewed and updated?		

	Additional Considerations for Installations Inside a Building or Basement	Y/N	Comments
36.	Does the territory or region where the installation is to take place permit chargers to be installed inside a building?		
37.	Have all options for installing chargers outside the building been explored and exhausted?		
38.	Is the fire rating of all structural elements which may be impacted by fire involving an EV at least 120 minutes?		
39.	Are all service penetrations fire stopped with fire rating commensurate to that of the structure?		
40.	Have all combustible elements of construction either been removed or protected?		
41.	Is the existing building fitted with an inspected, tested and maintained automatic sprinkler protection? If yes - are insurers and sprinkler contractors engaged in reviewing existing sprinkler design in the charging area? If no - has the installation of automatic sprinkler protection been considered in the management of change and risk assessment processes?		

	Additional Considerations for Installations Inside a Building or Basement Contd.	Y/N	Comments
42.	Is the existing building fitted with an automatic fire detection system which is inspected, tested and maintained? If yes - is automatic fire detection installed in the charging area? If no - will automatic fire detection be installed in the charging area?		
43.	Have all other ignition sources in or near the charging area been removed, isolated or assessed and deemed to be safe?		

	Additional Considerations for External Installations	Y/N	Comments
44.	Can the charging area be located at least 10 metres from all buildings including neighbouring occupancies and any yard storage areas?		
45.	Where installations are within 10m of the premises: • Is fire rating of the exposed wall known and documented? • Has all combustible construction in close proximity to the charging area been identified and removed/replaced with non-combustible type or otherwise protected with coatings or fire suppression? • Have all combustible facades, guttering, facias, etc. been identified and replaced with non-combustible type or otherwise protected? • Have all service penetrations been identified and fire-stopped? • Are there any combustible materials, flammable goods, critical infrastructure/plant/machinery/sprinkler valves/offices, immediately to the other side of the exposed wall?		
46.	Has there been a security review of the site?		

47.	Additional comments:

Please Note

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