



EUROPEAN PARKING ASSOCIATION

Positively promoting parking solutions for sustainable mobility

EPA Fire Safety

Toolbox

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EV charger guideline for fire safety

Introduction

The roll-out and widespread adoption of Electric Vehicles (EVs) and the associated charging infrastructure required means that there is a need for the retrofitting of a large stock of existing car parking buildings, as well as the introduction of charging facilities within new building designs.

At the same time, fires involving modern cars (not only EVs) can be larger than older vehicles and have the potential to have greater impact on building occupants as well as building fabrics. This has put scrutiny on existing fire safety provisions in car parks.

Fire safety rules and regulations vary between countries and regions. However, the fire safety considerations associated with the installation of EV chargers are the same regardless of geography. A first principles, evidence-based approach is needed.

The European Parking Association (EPA) has thus engaged Arup to assist in the development of an approach where available fire safety mitigation measures are collated and discussed. This document comprises the following:

Fire safety measures have been categorised based on fire safety benefits. A short discussion of the measure and notes are provided as to example European countries which currently require the measure as part of current regulations. It is based on current knowledge and is subject to change in response to further developments from fire safety research.

The document has tables which qualitatively indicate the merits of each measure and the circumstances and goals where they are relevant. The use cases include Enclosed/Open car parks and fire protection aims for life safety and property protection / operational continuity.

The toolbox is intended to be for guidance purposes only for owners/operators which are planning to install EV chargers in their car parks. It does not replace the need to comply with local requirements.

EV charger guideline for fire safety

Toolbox overview

Within the toolbox, two main types of car parks are considered:

Naturally ventilated car parks



Enclosed car parks



Note, the definition for naturally ventilated car parks varies between countries. However, the overall principle is naturally ventilated superstructure.

In addition, two fire safety objectives are considered:

1. Life Safety – Considered to be the minimum requirement that building codes aim to achieve. Includes the life safety of building occupants as well as fire-fighters intervening in an incident.
2. Operational continuity / property protection – Considered to be the protection of the asset / parking operations or the resilience of the asset against fire beyond the minimum requirements to safeguard life.



EV charger guideline for fire safety

Reference Documents

The information presented in this toolbox has been based upon work undertaken by Arup as part of developing guidance for government agencies. The outputs of this work is provided in:

- Office for Zero Emission Vehicles (UK). *T0194 – Covered car parks – fire safety guidance for electric vehicles* – Issued July 2023
- Australian Building Codes Board. *Fire safety in carparks: Literature review*. – Issued 28 February 2024.

The information represents the current state of knowledge, it is acknowledged that fire safety in car parks is an active field of fire research and regulatory activity.

Other national documents which have been reviewed as part of the development of this toolbox are listed on the next page.

EV charger guideline for fire safety

Reference guidance documents reviewed as part of toolbox development

Country	Guidance document	Notes
Belgium	Code of good practice – Fire safety for Electric Vehicles in Parking areas	Guidelines by the Fire forum (an NGO).
Denmark	Response to Fires in Electric & Hybrid Cars Siemens White Paper- ‘Fire safety in parking garages with electric vehicles’	Theme booklet produced by the Danish Emergency Management Agency. Not strictly applicable to a specific country, Drafted by Siemens in collaboration with Danish organisations (DBI & Danfoss).
France	Building code Fire prevention guide for covered parking areas (guide PS)	General building code but contains explicit specification relating to electric vehicles. Guidelines by the Ministry of Interior
Germany	SUVEREN- Fire protection guideline for car parks	Guidelines produced on the basis of the SUVEREN research project sponsored by the Federal Ministry of Education and Research
Italy	Guidelines for the installation of electric vehicle charging infrastructure	Guidelines by Italian firefighters.
Luxembourg	Fire prevention regulations – Covered parking for more than 20 vehicles	Technical regulation developed and applied jointly by the fire brigade and the labour inspectorate. General in nature but includes specifications for EV recharging points.
Netherlands	Fire safety of indoor car parks accommodating electrically powered vehicles	Guidelines developed by the NIPV (legally known as IFV).
Norway	Charging of electric cars in parking garages	Produced by RISE for the Norwegian Directorate for Civil Protection (DSB) and the Norwegian Building Authority (DiBK)
Spain (Barcelona)	Technical guide ‘Electric vehicle recharging installations’	Guidelines developed by the fire service of Barcelona, specific to Barcelona.
Sweden	Electric Vehicle Fire Safety in Enclosed Spaces	Literature review produced by RISE
Switzerland	Guidelines on lithium-ion batteries	Guidelines developed by Swiss association of insurers
United Kingdom	Risk control guide – RSA RC59 - FPA	Guideline drafted by UK insurers Guidelines developed by the UK Fire Protection Association (FPA)

EV charger guideline for fire safety

Light Electric Vehicles

- Parking and charging for light electric vehicles (LEVs) electric bikes and scooters is becoming more commonly accommodated within existing car parking structures.
- This document is focused on passenger vehicles and charging infrastructure around these. However, the following is noted in relation to LEVs:
- There have been a number of fires involving LEVs, which have been increasing in recent years, and concerns have been raised by fire services and others as to the appropriateness of having charging facilities in bike rooms.
- Whilst most international building codes do not yet have requirements for design for LEVs, international guidance from some fire brigades, researchers and building authorities has been published.
- An excerpt from an UK department for transport guidance note (titled ‘*e-cycle & e-scooter batteries: managing fire risk for premises*’), is provided on this page for information.
- The subject of LEV fire safety remains an active subject of research and regulatory activity. As such, the information provided on this page is non-exhaustive and operators should do their own due-diligence.

Recommendations
Locate charging facilities such that a fire cannot obstruct means of egress from the building.
Ground floor entry is preferred so that firefighters can get direct access from the fire engine parking location, and premises information and signage should be provided.
If storage/charging is to take place in a basement, existing smoke control systems may need upgrading
If no smoke ventilation system is in place, consider installing an automatically openable vent linked to the room’s fire detector and water-based fire suppression
A means of raising the alarm to alert all building residents should be in place along with smoke detectors
An external means to isolate the electrical power for the storage/charging room should be provided and clearly signposted
Consider the implications of possible high-temperature fires on the building structure
Fighting lithium fires often involves considerable amounts of water so consider how water run-off and contaminated water will be handled.
Ensuring that an adequate number of electrical outlets are supplied so that even at maximum capacity, users can connect chargers directly to a mains socket without the use of extension cords or adaptors.
Ensuring that the storage and charging area is not also used for other purposes that might increase fire risk, such as the storage of flammable materials

EV charger guideline for fire safety

Context for mitigation measures

- Fire safety guidance within EPA member countries set minimum fire safety precautions which are expected to be in place for compliance in the relevant countries. These provisions have not substantially changed for many years and would generally apply to existing and new car parks.
- It is important that car park owners, operators and/or designers establish what existing fire safety provisions are in place in the car park and how those are intended to operate in case of fire, as a baseline against which to assess what additional fire safety measures (if any) are needed to support the installation of EV charging points.
- This toolbox does not have in scope any evaluation of fire spread to other buildings. This may alter the recommendations.
- This guideline considers the baseline shown on the next page as a starting point. It is noted that specific countries have legislative requirements which are not identical to this baseline and the impact of this should be evaluated by the relevant owner/operator/designer. This includes where the legislative requirements are more onerous than the assumed baseline.

EV charger guideline for fire safety

Context for mitigation measures

Fire safety element	Common fire safety features
Evacuation strategy	Upon alarm, affected areas are evacuated.
Available escape routes	Minimum 2 from each floor.
Travel distances to protected escape routes	~20-30 m single direction, ~45-60 m multi-direction.
Fire detection	Manual call points. No automatic detection present. However, automatic interconnected fire detection is commonly present where enclosed cars are beneath other occupancies (i.e. below car park residential facilities).
Fire suppression	None. However, fire suppression commonly present where enclosed car parks are beneath other occupancies.
Structural fire resistance	~ 60 minutes.
Construction materials	Non-combustible.
Building envelope materials	Non-combustible.
Smoke ventilation	Natural ventilation / non smoke rated mechanical ventilation.
Firefighting access	Dependent on height / depth (if in an underground environment) & equipment/capability of local fire brigade.



Toolbox

Mitigation Measure Descriptions

Toolbox

Charger Installations



Mitigating Measure	Discussion of mitigating measure	Example countries where measure is a legal requirement (i.e. required by building code)
Charger Installations		
Provide certified and approved electric vehicle charge points	Electric Vehicle Charge points (EVCP) should meet the minimum set of technical regulation and be certified. EVCPs should ideally have overcurrent protection, tilt sensors, damage/fault reporting, temperature sensors and ventilation.	None, Generally recommended by relevant guidance
EVCPs installed by competent persons	EVCPs should be installed by persons with appropriate qualifications.	None, Generally recommended by relevant guidance
Provide a manual isolation switch to cut power supply to EVCPs	Cutting the supply of energy can control and reduce the likelihood of an energised electrical fire. These are primarily intended for firefighting use. However, it is noted that unwanted use of these should be mitigated against with good design. Some examples include locating the switch at the fire alarm panel or placing at height in agreement with local firefighters.	None, Generally recommended by relevant guidance
Provide automatic isolation of power supply linked to detection system / suppression system.	As per above but not linked to manual actuation.	None, Generally recommended by relevant guidance
Provide crash protection to the EVCP	Provides protection from impacts and as a result reduces the likelihood of faults developing in the EVCP. Note this applies primarily to pedestal mounted EV charging stations. Wall mounted stations may not require protection if the charger is mounted at height (~ 1.2 m).	None, Generally recommended by relevant guidance
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable	To reduce the risk of damage to the charging cables.	None, Generally recommended by relevant guidance
Provide security systems to deter deliberate damage	Security cameras and a management strategy can help to deter people deliberately damaging the EVCP.	None
Install Mode 3 or Mode 4 EVCPs (As defined by IEC 61851-1)	Mode 3 and Mode 4 type EVCPs have an in-built interface to monitor faults within the EVCP. Mode 2 chargers are not recommended to be installed. It is noted that Mode 4 EVCPs have potential fire hazards due to high charge-rates and thus place greater emphasis on appropriate installation.	None
Remove any faulty EVCPs or cables out of service	Charging with a faulty EVCP can lead to fires. EVCPs found to be faulty should be rectified before resuming service.	None, Generally recommended by relevant guidance
Consider the location of EVCPs.	The location of EVCPs should be considered in relation to the following factors to provide a balance which best satisfies the competing demands. It is understood that there is no single 'best place' to locate EVCPs: <ul style="list-style-type: none"> • Away from exits. • In areas where firefighters have ready access. • In areas with increased ventilation. 	None, Generally recommended by relevant guidance

Toolbox

Fire Detection & Alarm Systems

Mitigating Measure	Discussion of mitigating measure	Example countries where measure is a legal requirement (i.e. required by building code)
Fire Detection & Alarm Systems		
Provide automatic fire detection and alarm.	<p>Providing automatic fire detection and alarm will alert the occupants of a fire, allowing them to evacuate whilst the fire is in its early stages</p> <p>The provision of automatic fire detection allows early detection of a fire and can help facilitate first-aid firefighting intervention, e.g. by onsite management team (noting that not all car parks are managed by on-site staff), or early notification of the fire and rescue service.</p>	<p>Germany, Denmark</p> <p>Note: Dependent on car park size / other factors</p>
Provide thermal monitoring cameras within the car park.	Monitoring the temperature of the batteries within the EVs may give an indication of the status of the battery as it may detect early increases in temperature.	None
Provide voice alarm (linked to automatic detection) to alert occupants to evacuate.	A voice alarm is able to provide greater communication to occupants within the car park and can encourage occupants to evacuate quicker than a continuous siren, especially in unstaffed car parks. It is noted that voice alarm intelligibility can be difficult to achieve in all locations in some covered car parks which must be considered.	None
Link fire alarm to fire brigade dispatch.	<p>Linking any automatic fire alarm systems to the fire brigade dispatch could provide an enhanced response time. This must be balanced against potential false alarms.</p> <p>It is noted that not all countries permit the direct connection to fire brigade dispatch. It is recommended to consult with the local fire brigade as to the appropriate procedure to minimise call out times for confirmed fires.</p>	None

Construction materials and compartmentation

Mitigating Measure	Discussion of mitigating measure	Example countries where measure is a legal requirement (i.e. required by building code)
Construction materials and compartmentation		
Provide appropriate structural fire resistance within the car park	With the integration of EVs within car parks as well as modern car fuel loads, a minimum of 60 minutes structural fire resistance should be considered, unless additional measures such as water-based suppression is also installed, or extensive fire damage can be tolerated without impacting the life safety of occupants or firefighters. Car park specifics (e.g. geometry, adjacent structures) ultimately determine what structural fire resistance is appropriate and it is the responsibility of the design team to determine this	Netherlands, Denmark.
Maintain existing fire resisting construction (Fire stopping penetrations)	Provision of new penetrations and services can reduce the fire resisting performance of the wall. Prior to installing EVCPs, the location of existing lines of fire resistant construction within the car park should be identified and any penetration openings fire stopped to maintain the level of fire resistance of that element.	Required throughout Europe.
Provide fire resistant construction between parking bays	<p>If a parked car is involved in a fire, providing fire resistant construction between vehicles can reduce the likelihood of fire spread to adjacent vehicles.</p> <p>It is noted that this mitigation option carries substantial investment / effort with it which should be considered carefully.</p>	None
Building envelope design of limited combustibility	As EVs may be parked adjacent to walls, Euro class A1 or A2 classified elements for the façade system are recommended to limit fire spread from a potential EV fire via the external wall to other levels.	None
Increase distance between parked cars	<p>Increased distance between parked cars means that if a parked car is involved in a fire, the adjacent vehicle is exposed to less radiant heat and is therefore less likely to become involved in a fire.</p> <p>It is noted that this mitigation option carries substantial investment / effort with it which should be considered carefully.</p>	None

Toolbox



Active systems

Mitigating Measure	Discussion of mitigating measure	Example countries where measure is a legal requirement (i.e. required by building code)
Fire suppression		
Provide water-based fire suppression within the car park	<p>In the case of a vehicle adjacent to EV(s) being on fire, water-based fire suppression provides water coverage to the fire and the surrounding area, cooling to the surrounding environment and reduces the risk of increasing the temperature of the battery within the EV as a result of external heating.</p> <p>The provision of water-based fire suppression should in the event of vehicle fire reduce the rate of fire spread to adjacent vehicles thus minimising the spread of fire across the carpark and reducing the risk of structural damage and increasing the ability of the fire brigade to control the incident.</p> <p>The merits of sprinklers also reduces the risk of operational down time due to full floor or multiple levels being impacted by the fire event. Careful consideration is required for any retro fit of suppression especially in non-weathered naturally ventilated carpark levels where pre-action/dry pipe systems may be required to account for freezing/low temperature conditions.</p>	<p>Denmark</p> <p>Note: Only if car park is defined as enclosed rather than naturally ventilated.</p> <p>France (if more than 2 levels are provided)</p>
Provide manual firefighting measures in the vicinity of chargers	If fire extinguishers and dedicated EV fire blankets are provided near to the EV charging bays, this may allow early intervention.	None
Smoke exhaust		
Provide a smoke management system (within enclosed car parks).	Due to the greater presence of toxic gases released during an EV fire, a smoke clearance system with a set number of air changes per hour for a mechanical system or increased area of ventilation for a natural system could be provided. It is noted that definitions for natural ventilation vary depending on location.	UK, Ireland (Mechanical ventilation)
Firefighting access and facilities		
Provide firefighting water supply	More water is required to tackle an EV fire compared to an ICEV fire. When the battery becomes involved in an EV fire, the increased water supply is required to cool the deep-seated battery pack. It is recommended that local fire brigades are consulted as to their water needs.	Required throughout Europe
Provide premises informational plans to help inform firefighting operations	Additional information allows fire and rescue services to understand what measures are available in the building to protect firefighters and inform firefighting tactics to fight a fire.	None
Provide water run-off control and containment	The firefighting water/suppression used to fight an EV fire may contain higher concentrations of contaminants.	None
Provide access for removal of EVs that have been on fire	To minimise the risk of re-ignition of the battery, the EV that was on fire may need to be physically removed post-fire for monitoring and further extinguishment external to the covered car park.	None



Toolbox

Mitigation Measure Ratings

Toolbox

Recommendation ratings

- In the next pages, a qualitative evaluation of fire safety impact, cost of implementation (in terms of initial capital cost and operational cost) and, a general recommendation of whether the mitigation measure should be implemented when installing EV charging points is presented.
- The recommendations are made considering two separate user groups:
 - For operators where *life safety of occupants* is the primary goal.
 - For operators where *asset/property protection* and *operational continuity* are secondary requirements on top of *life safety of occupants*.
- The mitigation measures have then been categorised as follows based on ease of implementation and effectiveness:
 - Standard = Represents typical features expected to be implemented. This is independent of the effort required.
 - Moderate effort improvement = Further improvements to be considered above the standard.
 - Substantial effort improvement = Further improvements to consider which will require more in-depth analysis (including cost and feasibility of implementation and benefit assessments).
- It is noted that the recommendations here are not building specific and a building specific assessment may result in the need for additional measures.

Toolbox

Naturally ventilated car park – Life safety

Toolbox

Naturally ventilated car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Charger installations												
Provide certified and approved electric vehicle charge points			X	X			X			X		
EVCPs installed by competent persons			X	X			X			X		
Provide a manual isolation switch to cut power supply of EVCPs		X		X			X				X	
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables		X		X			X			X		
Provide car park layout that reduces the likelihood of collisions	X			X			X			X		
Provide crash protection to the EVCP	X			X			X			X		
Routine inspections by a competent organisation			X	X				X		X		
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable		X		X			X			X		
Provide security systems to deter deliberate damage	X			X			X				X	
Install Mode 3 or Mode 4 EVCPs		X			X		X			X		
Remove any faulty EVCPs out of service		X		X			X			X		
Consider the location of EVCPs		X		X			X			X		

Toolbox

Naturally ventilated car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Means of escape and warning												
Provide thermal monitoring cameras within the car park	X				X			X			X	
Provide automatic fire detection and alarm		X			X			X			X	
Provide voice alarm	X				X			X				X
Link fire alarm to fire brigade dispatch		X		X				X			X	
Construction materials and compartmentation												
Provide appropriate structural fire resistance within the car park			X		X		X			X		
Maintain existing fire resisting construction (Fire stopping penetrations)		X		X			X			X		
Provide fire resistant construction between parking bays		X				X	X					X
Building Envelope design of limited combustibility		X		X			X				X	
Increase distance between parked cars		X				X	X					X
Fire suppression												
Provide water-based fire suppression within the car park			X			X		X				X
Provide manual firefighting measures in the vicinity of chargers	X			X			X				X	

Toolbox

Naturally ventilated car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Smoke exhaust												
Provide a smoke management system	X					X		X				X
Firefighting access and facilities												
Provide firefighting water supply			X	X			X			X		
Provide premises informational plans to help inform firefighting operations	X			X			X			X		
Provide water run-off control and containment	X					X		X			X (depending on building circumstances)	X (depending on building circumstances)
Provide access for removals of EVs that have been on fire	X					X	X					X

Toolbox

Naturally Ventilated Car Park – Asset / property protection & operational continuity

Toolbox



Naturally ventilated car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Charger installations												
Provide certified and approved electric vehicle charge points			X	X			X			X		
EVCPs installed by competent persons			X	X			X			X		
Provide a manual isolation switch to cut power supply of EVCPs		X		X			X			X		
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables		X		X			X			X		
Provide car park layout that reduces the likelihood of collisions		X		X			X			X		
Provide crash protection to the EVCP		X		X			X			X		
Routine inspections by a competent organisation			X	X				X		X		
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable		X		X			X			X		
Provide security systems to deter deliberate damage	X			X			X			X		
Install Mode 3 or Mode 4 EVCPs		X			X		X			X		
Remove any faulty EVCPs out of service		X		X			X			X		
Consider the location of EVCPs		X		X			X			X		

Toolbox



Naturally ventilated car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Means of escape and warning												
Provide thermal monitoring cameras within the car park	X				X			X			X	
Provide automatic fire detection and alarm			X		X			X			X	
Provide voice alarm	X				X			X				X
Link fire alarm to fire brigade dispatch		X		X				X		X		
Construction materials and compartmentation												
Provide appropriate structural fire resistance within the car park			X		X		X			X		
Maintain existing fire resisting construction (Fire stopping penetrations)		X		X			X			X		
Provide fire resistant construction between parking bays		X				X	X				X	
Building Envelope design of limited combustibility			X	X			X			X		
Increase distance between parked cars		X				X	X				X	
Fire suppression												
Provide water-based fire suppression within the car park			X			X		X		X		
Provide manual firefighting measures in the vicinity of chargers	X			X			X			X		

Toolbox

Naturally ventilated car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Smoke exhaust												
Provide a smoke management system	X				X			X				X
Firefighting access and facilities												
Provide firefighting water supply			X	X			X			X		
Provide premises informational plans to help inform firefighting operations		X		X			X			X		
Provide water run-off control and containment		X				X		X			X (depending on building circumstances)	X (depending on building circumstances)
Provide access for removals of EVs that have been on fire			X			X	X				X	



Toolbox

Enclosed Car Park – Life Safety

Toolbox

Enclosed car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Charger installations												
Provide certified and approved electric vehicle charge points			X	X			X			X		
EVCPs installed by competent persons			X	X			X			X		
Provide a manual isolation switch to cut power supply of EVCPs		X		X			X				X	
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables		X		X			X			X		
Provide car park layout that reduces the likelihood of collisions	X			X			X			X		
Provide crash protection to the EVCP	X			X			X			X		
Routine inspections by a competent organisation			X	X				X			X	
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable		X		X			X			X		
Provide security systems to deter deliberate damage	X			X				X			X	
Install Mode 3 or Mode 4 EVCPs		X			X		X			X		
Remove any faulty EVCPs out of service		X		X			X			X		
Consider the location of EVCPs		X		X			X			X		

Toolbox



Enclosed car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Means of escape and warning												
Provide thermal monitoring cameras within the car park	X				X			X			X	
Provide automatic fire detection and alarm		X	X		X			X		X		
Provide voice alarm	X				X			X				X
Link fire alarm to fire brigade dispatch		X		X				X			X	
Construction materials and compartmentation												
Provide appropriate structural fire resistance within the car park			X		X		X			X		
Maintain existing fire resisting construction (Fire stopping penetrations)		X		X			X			X		
Provide fire resistant construction between parking bays		X				X	X					X
Building Envelope design of limited combustibility		X		X			X				X	
Increase distance between parked cars		X				X	X					X
Fire suppression												
Provide water-based fire suppression within the car park			X			X		X		X		
Provide manual firefighting measures in the vicinity of chargers	X			X							X	

Toolbox

Enclosed car parking – Life Safety

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Smoke exhaust												
Provide a smoke management system	X				X			X				X
Firefighting access and facilities												
Provide firefighting water supply		X		X			X			X		
Provide premises informational plans to help inform firefighting operations	X			X			X			X		
Provide water run-off control and containment	X					X		X			X (depending on building circumstances)	X (depending on building circumstances)
Provide access for removals of EVs that have been on fire	X					X	X					X

Toolbox

Enclosed Car Park – Asset / property protection & operational continuity

Toolbox



Enclosed car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Charger installations												
Provide certified and approved electric vehicle chargepoints			X	X			X			X		
EVCPs installed by competent persons			X	X			X			X		
Provide a manual isolation switch to cut power supply of EVCPs		X		X			X			X		
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables		X		X			X			X		
Provide car park layout that reduces the likelihood of collisions		X		X			X			X		
Provide crash protection to the EVCP		X		X			X			X		
Routine inspections by a competent organisation			X		X			X		X		
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable		X		X			X			X		
Provide security systems to deter deliberate damage	X			X				X		X		
Install Mode 3 or Mode 4 EVCPs		X					X			X		
Remove any faulty EVCPs out of service		X		X			X			X		
Consider the location of EVCPs		X		X			X			X		

Toolbox



Enclosed car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Means of escape and warning												
Provide thermal monitoring cameras within the car park	X				X			X			X	
Provide automatic fire detection and alarm		X			X			X		X		
Provide voice alarm	X				X			X				X
Link fire alarm to fire brigade dispatch		X		X				X		X		
Construction materials and compartmentation												
Provide appropriate structural fire resistance within the car park			X		X		X			X		
Maintain existing fire resisting construction (Fire stopping penetrations)		X		X			X			X		
Provide fire resistant construction between parking bays		X				X	X				X	
Building Envelope design of limited combustibility		X		X			X			X		
Increase distance between parked cars		X				X	X				X	
Fire suppression												
Provide water-based fire suppression within the car park			X			X		X		X		
Provide manual firefighting measures in the vicinity of chargers	X			X			X			X		

Toolbox

Enclosed car parking – Asset / property protection & operational continuity

Mitigation measure	Fire safety benefit			Capital cost			Operational cost			Recommendation Category		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Standard	Moderate Effort	Substantial Effort
Smoke exhaust												
Provide a smoke management system	X				X			X			X	
Firefighting access and facilities												
Provide firefighting water supply		X		X			X			X		
Provide premises informational plans to help inform firefighting operations		X		X			X			X		
Provide water run-off control and containment	X					X		X			X (depending on building circumstances)	X (depending on building circumstances)
Provide access for removals of EVs that have been on fire	X					X	X			X		



Toolbox

Case Studies

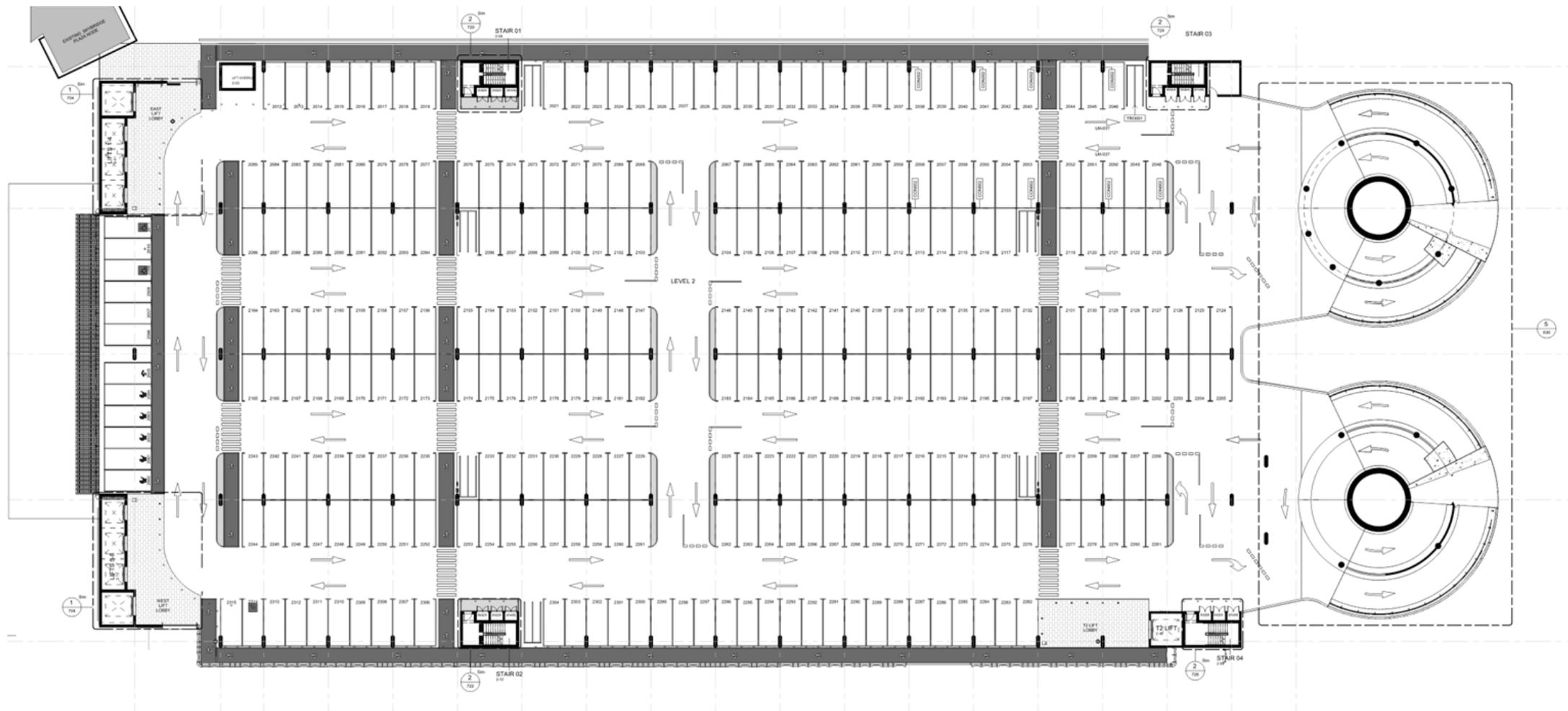
Case Study 1

Background Information

- A naturally ventilated car park (on all sides).
- The car park is multi-storey and standalone
- EV chargers are to be retrofit into the existing building.
- The study concerns life safety needs.
- The example represents a single potential use of the toolbox to tailor mitigation measures to the fire strategy of the building.
- Commentary has also been provided to inform the reader about considerations that may influence the adoption (or not) of certain mitigation measures.
- This case study does not address fire spread to adjacent buildings which may necessitate additional measures to control fire spread.

Case Study 1

Floorplate Layout



Case Study 1

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Charger installations			
Provide certified and approved electric vehicle charge points	Standard	Yes	Charge points according to EN IEC 61851-1:2019 in conjunction with the relevant parts of the EN IEC 61439 series & EN IEC 62208:2023
EVCPs installed by competent persons	Standard	Yes	
Provide a manual isolation switch to cut power supply of EVCPs	Moderate effort	Yes	Should be located in an area easily reachable by firefighters. Within the vicinity of a fire alarm panel (if present).
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables	Standard	Yes	
Provide car park layout that reduces the likelihood of collisions	Standard	Yes	
Provide crash protection to the EVCP	Standard	Yes	
Routine inspections by a responsible organisation	Moderate effort	Yes	Recommended to be implemented as part of good practice for customer service.
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable	Standard	Yes	
Provide security systems to deter deliberate damage	Moderate effort	Yes	Linked to other security measures (e.g. CCTV) provided within the car park.
Install mode 3 or Mode 4 EVCPs	Standard	Yes	Mode 3 chargers considered to have relatively lower risk associated.
Remove any faulty EVCPs out of service	Standard	Yes	Faults can be identified through regular inspections as well as with automatic monitoring.
Consider the location of EVCPs	Standard	Yes	Location recommendations with rationale highlighted on the next page

Case Study 1

Charger locations in order of preference



Notes

Well ventilated (on perimeter), Easily accessed by firefighters (close to fire-fighting stairs), Does not impact on egress routes

Ventilated (but on floorplate), Easily accessed by firefighters (relatively close to fire-fighting stairs), Minor impact on egress routes (alternative routes available)

Ventilated (but on floorplate), challenging fire-fighting access (far from fire-fighting stairs), minor impact on egress routes (alternative routes available)

Case Study 1

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Means of egress and warning			
Provide thermal monitoring cameras within the car park	Moderate effort	No	Thermal monitoring cameras could provide an improvement for asset protection / operational continuity by providing means of detecting elevated temperatures prior to onset of thermal runaway.
Provide automatic fire detection and alarm	Moderate effort	Yes	A thermal detection system provided due to car park size. Omission of detection could be considered by the stakeholders.
Provide voice alarm	Substantial effort	No	Achieving sufficient speech intelligibility for voice alarm systems within car parks can prove difficult.
Link fire alarm to fire brigade dispatch	Moderate effort	No	Could be considered by the stakeholders as an improvement for asset protection.
Construction materials and compartmentation			
Provide appropriate structural fire resistance within the car park	Standard	Yes	A minimum of 60-minute fire resistance is considered appropriate.
Maintain existing fire resisting construction (Fire stopping penetrations)	Standard	Yes	Fire separation between floor levels within the sample design is provided via solid floor slabs & external ramp locations.
Provide fire resistant construction between parking bays	Substantial effort	No	For life safety purposes, in this instance, the value of providing fire resistant construction between bays is limited in comparison with the impact on daily usability & cost.
Building Envelope design of limited combustibility	Moderate effort	Yes	Provided to limit potential for fire spread between levels.
Increase distance between parked cars	Substantial effort	No	Gaps between parked banks of cars are provided by this design via the egress routes. However, separation between individual bays was not considered appropriate by the stakeholders. As an existing structure, increasing distance is challenging.

Case Study 1

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Fire suppression			
Provide water-based fire suppression within the car park	Substantial effort	No	As the car park is existing, retrofitting suppression is considered prohibitively challenging. For new structures and if the goal is for property protection the stakeholders may re-evaluate this conclusion.
Provide manual firefighting measures in the vicinity of chargers	Moderate effort	Yes	Provided in the form of fire extinguishers located in the vicinity. Other measures such as fire blankets may be considered.
Smoke exhaust			
Provide a smoke management system (note that an open-sided car park would not be expected to have a mechanical system)	Substantial effort	No	The sides of the car park should be open and no mechanical systems would be expected. The design of the car park should ideally facilitate smoke movement (e.g. with sufficient floor-ceiling heights).
Firefighting access and facilities			
Provide sufficient firefighting water supply	Standard	Yes	Should be evaluated in consultation with local guidelines and firefighters.
Provide premises informational plans to help inform firefighting operations	Standard	Yes	Mounted by the primary entrance which firefighters would be expected to use and around the fire detection panel.
Provide water run-off control and containment	Substantial effort	No	As an existing structure, the level of effort required for retrofit of water containment is considered prohibitive
Provide access for removals of EVs that have been on fire	Substantial effort	No	

Case Study 2

Background Information

- An enclosed car park.
- The car park is located within a basement underneath another occupancy.
- EV chargers are to be included as part of a new development.
- The study concerns life safety needs.
- The example represents a single potential use of the toolbox to tailor mitigation measures to the fire strategy of the building.
- Commentary has also been provided to inform the reader about considerations that may influence the adoption (or not) of certain mitigation measures.
- This case study does not address fire spread to adjacent buildings which may necessitate additional measures to control fire spread.

Case Study 2

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Charger installations			
Provide certified and approved electric vehicle charge points	Standard	Yes	Charge points according to EN IEC 61851-1:2019 in conjunction with the relevant parts of the EN IEC 61439 series & EN IEC 62208:2023
EVCPs installed by competent persons	Standard	Yes	
Provide a manual isolation switch to cut power supply of EVCPs	Moderate effort	Yes	Should be located in an area easily reachable by firefighters. Within the vicinity of a fire alarm panel (if present).
Provide automatic isolation of power supply linked to detection system / suppression system / automatic de-energisation of connection cables	Standard	Yes	
Provide car park layout that reduces the likelihood of collisions	Standard	Yes	
Provide crash protection to the EVCP	Standard	Yes	
Routine inspections by a responsible organisation	Moderate effort	Yes	
Position the EVCP so that the charging cable can easily attach to the EV with a minimum length of cable	Standard	Yes	
Provide security systems to deter deliberate damage	Moderate effort	Yes	
Install Mode 3 or Mode 4 EVCPs	Standard	Yes	Linked to other security measures (e.g. CCTV) provided within the car park.
Remove any faulty EVCPs out of service	Standard	Yes	Mode 3 chargers considered to have relatively lower risk associated.
Consider the location of EVCPs	Standard	Yes	Location recommendations with rationale highlighted on the next page

Case Study 2

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Means of egress and warning			
Provide thermal monitoring cameras within the car park	Moderate effort	No	
Provide automatic fire detection and alarm	Moderate effort	Yes	Thermal detection provided (sprinklers)
Provide voice alarm	Substantial effort	No	Due to difficulty with speech intelligibility
Link fire alarm to fire brigade dispatch	Moderate effort	Yes	Could be re-considered by the stakeholders.
Construction materials and compartmentation			
Provide appropriate structural fire resistance within the car park	Standard	Yes	A minimum of 60-minute fire resistance is considered appropriate
Maintain existing fire resisting construction (Fire stopping penetrations)	Standard	Yes	
Provide fire resistant construction between parking bays	Substantial effort	No	Protection by a suppression system (selected in this case) is considered to provide means to mitigate the potential for spread between parking bays, thus this mitigation measure has not been selected.
Building Envelope design of limited combustibility	Standard	Yes	
Increase distance between parked cars	Substantial effort	No	Gaps between parked banks of cars are provided by this design via the egress routes. However, mitigation of potential fire spread between cars is provided by the suppression system

Case Study 2

Standalone - Life safety focus

Mitigation Measure	Recommendation category	Selected for application?	Notes
Fire suppression			
Provide water-based fire suppression within the car park	Standard	Yes	Sprinkler system specified to OH 2 in line with EN 12845.
Provide manual firefighting measures in the vicinity of chargers	Moderate effort	Yes	In the form of fire extinguishers.
Smoke exhaust			
Provide a smoke management system	Moderate effort	Yes	This can be in the form of fire rated wiring & components of the existing mechanical ventilation system provided for day-to-day operations. While not a fully-fledged smoke management system, this would be expected to provide an improved environment for fire-fighters.
Firefighting access and facilities			
Provide sufficient firefighting water supply	Standard	Yes	
Provide premises informational plans to help inform firefighting operations	Standard	Yes	
Provide water run-off control and containment	Substantial effort	No	For life safety purposes, the level of effort required for retrofit of water containment is considered prohibitive.
Provide access for removals of EVs that have been on fire	Substantial effort	No	



The European Parking Association (EPA), founded in 1983, is the umbrella organisation for the parking sector in Europe. The Full Members, national parking associations, represent both public and private bodies that are operating and managing on- and off-street parking structures and services. The Corporate Members represent the supply industry that offers all related products and services concerned with parking and urban mobility. EPA aims to facilitate cooperation between the national parking organisations of all European countries, as well as the exchange and mutual support of professional experience among its members related to smart parking management and sustainable urban mobility.

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