Loss Prevention Standards – Asset Class(es)

Small Scale Battery Energy Storage Systems

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Small scale Battery Energy Storage Systems (BESS) are typically used by organisations to manage energy usage/efficiency and meet Environmental, Sustainability and Governance (ESG) goals.

The presence of batteries, particularly lithium-ion batteries, can however create added fire and explosion hazards, and this Loss Prevention Standard provides guidance to help reduce the potential for such loss or damage.

AVIVA

Small Scale Battery Energy Storage Systems

Introduction

Battery Energy Storage Systems (BESS) are an efficient means of capturing and storing energy. They are commonly used to store electrical power, purchased from the grid at lower demands, for later use. Other uses may include use with other renewable energy technologies, such as wind turbines or photovoltaic solar panel systems to store energy for export at higher demands.

Whilst these systems have a proven track record of safe operation, a number of significant losses have been reported in recent years including a fire at an energy storage facility in Liverpool which resulted in the loss of a containerised BESS and associated equipment.

This document provides useful guidance to help prevent fires and other losses or damage in relation to small scale lithium-ion BESS located on business premises.

Note: This document is focussed on Property loss prevention in relation to small scale lithium-ion battery BESS. It is not intended to address grid scale BESS installations which are addressed in Aviva Loss Prevention Standard **Grid Scale Battery Energy Storage Systems**, Liability exposures, nor BESS featuring other battery technologies, although much of the guidance provided will be relevant. The presumption is that all regulatory requirements, Fire Risk Assessments, and compliance with requirements placed by the local authority having jurisdiction which would include licencing, building permissions, regulations, codes, or standards, have or will be met.

Background

Battery Energy Storage Systems have been in development and operation since the 1980's. The earlier systems comprised large lead acid batteries housed within dedicated buildings. The development of lithium-ion batteries helped streamline the scale of BESS, as well as other efficiency benefits, and containerised and other enclosed equipment were developed and put into use from around 2010. In recent years small scale BESS have become an increasingly popular means of storing generated or purchased electrical energy. Small scale BESS is mainly used to offset energy usage and may despatch electrical power to the grid at an agreed contractual price. This is opposed to grid scale installations, which perform multiple grid services and bid into the UK Capacity market auctions.

BESS comprise a number of key components, namely:

Batteries

The system features a number of battery racks, which will vary based upon the manufacturing design and size of the enclosure. Whilst battery types vary, prismatic cells which support regular deep discharge; provide longer life; and increased power storing capability, are the most favourable type of cell.

Note: Other battery technologies can be used, however lithium-ion is currently the most prevalent. In terms of lithium-ion battery chemistry, Lithium Iron Phosphate (LFP) batteries are considered more favourable to other lithium-ion battery chemistries such as Lithium Nickel Manganese Cobalt Oxide (NMC). LFP batteries typically have a higher thermal runaway temperature threshold, meaning there is more potential to shut down an overheating system before it reaches thermal runaway.

Thermal runaway is a violent chain reaction of exothermic chemical reactions in a battery resulting in an uncontrollable increase in temperature, and anticipated destruction of the battery and a fire or explosion event.

Enclosure

Common enclosure types include:

- **Modular/segmented** – The key components are housed together within smaller individual metal cabinets, including several cabinets housing batteries, often in back to back configurations.
- **Cabinets** – Ranging from small cabinets to larger units, these are narrower than traditional container type enclosures, allowing back to back configurations and have less energy per module.
- **Container** – The container type enclosures range in size, typically between 6 and 12 metres in length and around 2.5 metres high and wide.

Other design features within the enclosure can include environmental control via air conditioning; fire barriers; explosion venting and accessibility for ease of inspection and maintenance.

Inverters

The batteries produce Direct Current (DC) current which needs to be converted into an Alternating Current (AC) supply for use at the site, and/or sale to the national distributor. An inverter is a device that regulates the flow of electrical power. Fundamentally, an inverter accomplishes the DC-to-AC conversion, by switching the direction of a DC input back and forth very rapidly. As a result, a DC input becomes an AC output.

Inverters can be located in the enclosure, however, are usually located separately to the BESS enclosure.

Battery Management System

The Battery Management System (BMS) helps ensure the batteries operate within safe appropriate charging and discharging parameters, as well as managing state of charge, measuring performance against stated Key Performance Indicators (KPI's), temperature output, cell balancing etc.

System Controller

The controller performs a similar role to BMS, however it monitors, controls, and protects the whole BESS and its key components. It also communicates performance data to the monitoring system.

Cooling system

Methods of cooling generally comprise:

- **Air cooling** - Open systems where air is drawn into the enclosure, chilled and circulated to cool the enclosures. Some systems can result in increased moisture levels within the BESS, a potential fire and decomposition risk. Air cooling is also less able to cool evenly within the BESS.
- **Liquid cooling** – Will often be used to cool batteries locally in BESS enclosures, and generally preferred over air cooled systems due to the lack of moisture and other contaminants generated.

Explosion Ventilation

During a thermal runaway event, the battery enclosure should have methods of venting out gases to prevent buildup inside the enclosed space. These methods typically comprise:

- Passive ventilation – Use of pressure relief panels that open once pressure inside enclosures reaches a threshold level.
- Active ventilation – Use of fans to circulate gases out of the enclosure.
  - ✓ **NFPA 68 – Passive Explosion Mitigation and/or NFPA 69 – Standard on Explosion Prevention Systems** provide guidance on enclosure ventilation.

Note: Small scale enclosures will typically only feature air circulation fans, as the reduced energy capacity relates to reduced explosion risks.

- **Monitoring System.** These communicate the system outputs and other relevant data, allowing the system to be supervised.
- **Transformer Equipment.** The inverter will connect to on-site Medium Voltage (MV) transformer equipment to step up the voltage from the BESS before connecting to the national power distribution system.

Understanding the Risks

The lithium-ion batteries used in BESS are generally safe and reliable to use. If the battery packs are manufactured to acknowledged quality standards, transported correctly and once in use are charged/discharged, cooled, and monitored appropriately, the risks of fire and explosion are low. The consequences of a fire or explosion involving lithium-ion batteries within a BESS can however be significant and concerns include:

Smoke/off gassing

Combustion products are highly damaging, corrosive, and can damage buildings and assets. They are also toxic, and their inhalation can lead to long term health impacts, and exposure in high concentrations can lead to fatalities.

Vapour Cloud Explosion

The initial off gassing associated with lithium-ion battery failure contains a number of highly flammable gases, which can accumulate within the enclosure, and if ignited can lead to deflagration incidents.

Note: Deflagration is a form of explosion where the flame speed is lower than the speed of sound and usually occurs within a confined environment, such as a BESS. The other form of explosion is a detonation, where the flame speed is faster than the speed of sound and confinement is not required. Detonation is associated with materials such as dynamite, Trinitrotoluene (TNT) and hydrogen gas, rather than BESS.

Thermal Runaway/Fire

Following the initial off-gassing event, the batteries may enter thermal runaway and ignition. Thermal runaway typically occurs in response to damage, such as dropping or impact; manufacturing faults; internal short circuiting; charging issues etc. and is characterised by:

- An increase in internal battery temperature.
- The creation of flammable gases and combustible hydrocarbons that are readily ignitable.
- Fire and deflagration potential.

A fire event can be prolonged in the BESS due to a cascade of thermal runaway across the battery cells within modules and the battery rack. Lithium-ion battery fires are also extremely difficult to extinguish and can reignite in some cases due to ongoing chemical decomposition. There have been instances of BESS fires taking several days to bring under control.

The amount of firefighting water used in tackling a BESS fire incident can be significant with contaminated run off water presenting environmental risks requiring careful management due to the contaminated fire water run off being considered in many territories as ‘hazardous waste’. Aviva are aware of significant incurred costs for removing and processing such contaminated run off water and this **MUST** be factored into any emergency response and recovery plans. Refer Aviva Loss Prevention Standard **Contamination Following a Fire for** further guidance.

Fire originating in a BESS can spread to nearby adjacent property and assets including buildings, stock, vehicles, and equipment, leading to increased property and business interruption losses. The BESS may also be vulnerable to fire originating from such locations.

Management of Change

Ensure the installation work is managed under a Management of Change programme and all relevant stakeholders are involved in design, planning and installation discussions, including your Property Insurer/Broker.

- Close project management can help reduce the potential for errors, delays, expensive rectifications, and unplanned changes.
- Refer Aviva Loss Prevention Standard **Managing Change – Property** for guidance.

Note: Use and charging of lithium-ion batteries within BESS enclosures may create additional duties under explosive atmospheres regulations, depending on the nature and extent of other activities undertaken. In the United Kingdom this is currently addressed via The Dangerous Substances and Explosive Atmospheres Regulations 2002. Any obligations under these Regulations, or other corresponding International Regulations/Directives if based overseas, should be investigated and any actions generated should be addressed promptly.

Design Considerations

Location (External BESS)

Fire and/or deflagration events within a BESS can cause damage to adjacent property, and significant impacts to trading, depending on the criticality of the damaged property. The location of the BESS enclosures and associated equipment is therefore critical in managing the site's fire and deflagration exposures.

The BESS should be located externally and at least 10 metres separation should be maintained between BESS enclosures and other buildings or critical assets such as High Voltage (HV) Transformers; back-up generators; fuel tanks; electrical vehicle charging facilities; sprinkler tanks and sprinkler equipment; combustible items, yard, and waste storage.

  - ✓ Where the separation configuration cannot be changed, a fire barrier should be installed between the BESS and the adjacent asset.
  - ✓ Any barriers used should have a fire resistance rating (insulation and integrity) of at least 120 minutes and extending at least 1m over the height and width of the BESS enclosures.
  - ✓ The installation of fire barriers should be completed by a reputable and accredited company, such as those certificated to LPCB Loss Prevention Standard **LPS 1271: Requirements for the LPCB Approval and Listing of Companies Installing Fire or Security Doors, Door-sets, Shutters and Active Smoke/Fire Barriers** in the United Kingdom.
- At least 4.5 metres separation should be maintained between any large container type BESS enclosures in the installation.
- At least 1.5 metres separation should be maintained between the BESS enclosure and associated inverters and Medium Voltage (MW) transformers.
- The area between the BESS enclosures and other buildings, or assets etc., should be maintained totally clear of vehicles, combustible items, waste etc., at all times, to prevent the risk of fire bridging.
- The BESS should not be installed in close proximity to critical overhead electrical or telecommunications lines, equipment, or poles.
  - ✓ Deflagration venting systems are typically located on the roof of BESS enclosures and a fire or explosive event is likely to damage equipment sited directly over the enclosure.
- The BESS should not be located in close proximity to watercourses or areas of environmental importance.
  - ✓ In the event of fire, run off products from firefighting can contaminate waterways and protected land.
  - ✓ If this is unavoidable, undertake a risk assessment and ensure adequate protections such as bunding, emergency containment etc., are available to trained persons.

Note: The above separation guidelines are minimum standards, and Aviva recommends BESS are located externally and at least 10m away from buildings and any other valuable assets.

Important: Internally located BESS are not recommended under any circumstances. Where this is the last resort after all other options have been considered, refer to Appendix A at the end of this document for key guidance.

System Design

- The BESS should be manufactured by a reputable and experienced company.
- It should be tested to be compliant with an established safety standard.
  - ✓ **UL 9540: Energy Storage Systems** is an established testing standard.
  - ✓ The system should also have been tested using test standard **UL 9540A: Evaluating Thermal Runaway Response,** and the results incorporated into the system design.
    - This should be evidenced where possible.
  - ✓ Small scale type BESS should also be tested to **UL 9540B Safety Testing for Residential Energy Storage Systems (ESS)**.
- All BESS enclosures should be of non-combustible construction with any insulation materials also rated as non-combustible.
  - ✓ In the United Kingdom and Europe this would be materials classified as A1 or A2 under **BS EN 13501-1:2018 – Fire classification of construction products and building elements - Classification using data from reaction to fire tests**.
- Container type BESS that are located in proximity to buildings, valuable assets etc should also achieve a fire resisting rating (insulation and integrity) of 60 to 120 minutes.
  - ✓ In the United Kingdom and Europe this would be materials classified REI 90 to REI 120 under **BS EN 13501-2:2023 - Fire classification of construction products and building elements - Classification using data from fire resistance and/or smoke control tests, excluding ventilation services**.
- BESS should be protected against the risks of lightning damage including surge and transient surge.
  - ✓ A lightning/surge risk assessment should be completed by a competent person or company, preferably a member of a recognised quality scheme or body such as the Association of Technical Lightning and Access Specialists (ATLAS), and any necessary or additional lightning/surge protection systems should be installed in accordance relevant standards, such as **BS EN 62305 pts 1 to 4 – Protection Against Lightning to determine the direct and secondary effect protection** in the United Kingdom.
  - ✓ Small scale equipment may have inbuilt lightning/surge protection. This should be verified and if necessary additional protections incorporated following a lightning/surge risk assessment.
- BESS should be installed in accordance with national or international regulations, standards, or codes, such as:
  - ✓ **NFPA 855 – Standard for the Installation of Energy Storage Systems**. This standard provides the minimum requirements for mitigating the hazards associated with BESS.
- BESS enclosures should be mounted on foundations which have been designed by a competent person and deemed suitable for the specific location, factoring in site ground and water conditions.
- Cabling and other services should be located underground in back filled cable ducting to help avoid wear and tear, impact, or weather related damage etc.
  - ✓ Where this is not achievable, appropriate cable trunking/trays should be utilised and located in areas where the risks of damage are minimised and suitably protected.

Inverters

Ensure inverters have an adequate Ingress Protection (IP) rating for external use and are not unduly exposed to harsh weather conditions or impact damage from any vehicles or from stored materials etc.

- ✓ **UL1741 Safety of Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources** sets out the manufacturing (including software) and product testing requirements for inverters used for grid connection applications.

Transformers

All transformers should be manufactured, tested and installed to recognised regulations, standards or codes, such as BS EN IEC 60076 - Power Transformers in the United Kingdom, and be subject to a formal maintenance programme which includes condition inspection; dissolved gas analysis and insulation resistance testing.

Installer

Ensure competent and experienced installers are utilised.

- Companies, and any third party contractors, should be reputable and experienced in BESS design and installation projects.
- Electrical engineers should be qualified to install and maintain electrical systems in compliance with national regulations, standards, or codes.
  - ✓ In the United Kingdom this is **BS 7671: 2018 Requirements for Electrical Installations IET Wiring Regulations (18th Edition)**.
  - ✓ Specific electrical energy storage systems training courses are available to qualified electrical engineers, and any electrical engineer installing a BESS should have undergone such training and be able to provide certification upon request.

Cooling Systems

Cooling systems and optimal operating temperatures vary across different manufacturers, however many BESS enclosures generally operate safely from around 15° to 50° Celsius.

- The optimal operating temperature within a BESS enclosure is maintained by the battery management system.
  - ✓ The battery management system should be configured to alarm and isolate the BESS if temperatures exceed specified temperature thresholds.
- The whole enclosure and all battery racks should be cooled evenly to help prevent hot spots developing.
  - ✓ The use of thermographic cameras can help identify cooling issues within the enclosure.
- The cooling systems should not be powered by the BESS system.
- Closed loop liquid cooling systems, typically a water and glycol mix, should be utilised where possible.
  - ✓ Closed loop systems help prevent external contaminants entering the enclosure.
  - ✓ Liquid cooling is extremely effective at dissipating large amounts of heat and maintaining uniform temperatures within the BESS enclosure.
- If any air cooled systems are utilised, ensure:
  - ✓ Such a system is appropriate for the anticipated ambient air temperatures in the region and the associated seasons. In colder climates this make take the form of an environmental temperature control system which may provide heating and cooling as required to maintain a stable temperature in accordance with the BESS manufacturers recommendations.
  - ✓ The batteries are adequately cooled.
  - ✓ The BESS enclosure is regularly inspected to ensure moisture levels are appropriate and no wear or corrosion is developing.

Note: If the BESS is sited in an extremely cold location, heating systems may be necessary. The BESS designer should be able to provide appropriate guidance.

System Controller and Monitoring

The BESS should be monitored and configured to alert key personnel in the event of any reported performance discrepancies or deviations.

- Ensure there is adequate communications redundancy.
- Dual transmission systems should be considered where provided or available.

Battery Management Systems (BMS)

Ensure a good quality BMS is utilised. Whilst different BMS provide various features, the following are deemed critical:

Real-time Monitoring. The main parameters such as voltage, current, and temperature of the battery cells via module fan speed, ensuring optimal performance is achieved.

Charging/Discharging. The BMS manages charging/discharging cycles, helping improve battery life/performance.

Charge Balancing. The BMS ensures the battery cells are charging uniformly, improving battery performance, and ensuring uniform battery balancing within the enclosure.

Safety Protections. These include overcharge and discharge issues, overcurrent, and thermal management. Upon detection the BMS can implement corrections or protection controls.

Data Sharing. The BMS will share performance data with the monitoring systems to ensure appropriate supervision and logging of issues.

The BMS should be configured to safely isolate the BESS if prescribed high temperature thresholds are achieved, or other hazardous performance characteristics are indicated e.g. increased resistance, that could lead to a thermal runaway event.

Ventilation

The BESS will feature ventilation to help control temperature and remove flammable gases in an off gassing incident.

Active ventilation. Active ventilation is linked to the BMS and any provided gas detection equipment (see below).

- Container type BESS enclosures should feature appropriate active ventilation, rated as suitable for use in explosive atmospheres and interlocked to the BMS and/or gas detection to activate upon detection of early gas release or faults identified by the monitoring equipment.
  - ✓ This should be powered independently of the BESS enclosure, and additional back-up power should be provided to ensure autonomous operation in the event of an off gassing event.
- The exhaust point of the ventilation system and the passive ventilation venting should be to a safe area in the open to help avoid contaminating the air intake to buildings, other enclosures etc., in proximity.
- The ventilation system should operate continuously. They should not be compromised or stopped by the actuation of any fire detection or protection systems.

Passive ventilation. Venting, typically in the form of fixed vent panels that open in a deflagration event, should be fitted to container type BESS. It should be designed on the expected worst case scenario.

- Such systems should be designed, tested, installed, and maintained by a competent and experienced company in accordance with appropriate testing standards.
  - ✓ Refer **NFPA 68 - Passive Explosion Mitigation, NFPA 69 – Standard on Explosion Prevention Systems, BS EN 14797:2006 - Explosion venting devices or FM7730 Examination Standard for Explosion Venting Devices** for further guidance.

Note: Small scale BESS enclosures will generate significantly less explosive potential and may utilise air circulation fans. These should however be rated and suitable for use in potentially explosive environments.

Gas Detection

An automatic gas detection system, designed for the detection of lithium-ion battery off gassing, should be installed within container type BESS enclosures. Off gases from such batteries comprise a blend of flammable gasses that will be both heavier and lighter than air. As a result, detection will be expected at floor and ceiling level.

Gases include: Carbon Monoxide, Carbon Dioxide, Hydrogen, Methane, Acetylene, Ethylene, Ethane, Propene, Propane, and other hydrocarbons.

- The detection systems should be interlocked to the power supply and charging systems to isolate upon the immediate detection of gases and prior to thermal runaway.
  - ✓ The interlock should be tested at least annually and restored following any impairment to the detection system.
- The detection system should be suitably rated for use in potentially explosive atmospheres.
- An accredited fire protection installer can provide further guidance and assistance.

Fire Protection

Suppression Systems

Water based or gaseous fire suppression systems are not recommended within BESS enclosures.

- Water reacts violently with lithium and can produce hydrogen gases, increasing the deflagration potential within the BESS enclosure. Damaged batteries are more susceptible to facilitating the reaction.
  - ✓ The modules and racks are also confined, potentially limiting water access to the seat of the fire.
- Automatically operating gaseous fire suppression systems are often installed within BESS enclosures, however, are designed to only suppress fire starting within electrical components/switchgear etc. and are not effective in suppressing lithium-ion battery fires.
  - ✓ Activation of such a protection may also increase the pressure within the enclosure and accelerate the internal enclosure environment reaching its lower explosive limit, potentially increasing the risk of early deflagration, and are not recommended.

Further guidance on the suitability of suppression systems, should be obtained from your Property/BESS Insurer and Insurance Broker.

Fire Extinguishers

- Fire extinguishers specified for use in tackling lithium-ion battery fires are available, however whilst potentially providing some benefit require very early application and, may not fully extinguish a developing fire involving larger lithium-ion battery arrangements or prevent the batteries reigniting. The volatility of lithium-ion battery fires and their explosive characteristics also presents significant injury risks to persons tackling such a fire in proximity, and as such their use is not recommended within BESS enclosure.
  - ✓ Further Guidance on fire extinguishers is provided in Aviva Loss Prevention Standard **Fire Extinguishers**.

Maintenance

All BESS equipment including batteries, cooling, and ventilation, BMS, controller systems, gas detection and monitoring systems should be serviced and maintained in accordance with Original Equipment Manufacturer (OEM) and/or system installer guidelines/instructions.

- Servicing, and maintenance to be completed in accordance with the manufacturers recommendations, and which may be performed twice yearly or annually by competent and experienced companies.

- The maintenance company, using manufacturers guidance and performance data will replace aged or degrading cells as part of the formal maintenance programme.
- Any damaged or faulty lithium-ion battery cells noted during self-inspections should be reported to the maintenance company immediately, and the BESS isolated pending formal inspection and repair.
  - ✓ Damaged cells should be removed from the premises by the maintenance company following replacement works.
  - ✓ Removed battery cells/modules should be safely segregated from enclosures, buildings, valuable assets, and combustible items such as waste stores, pallets etc., pending removal. At least 10m separation is recommended.

Self-inspection

A programme of regular self-inspections should be established and include:

- External inspection of the BESS enclosure(s), including openings vents, footings, security locks, protective seals etc.
- External checks of the cabling systems, inverter(s), and transformer(s) for signs of damage, leaks, corrosion, water ingress etc.
- Visual inspection of the battery racks and modules for evidence of damage, leaking, corrosion etc.
- Visual inspection of electrical wiring, joints, connectors, and junction boxes for evidence of wear, fraying, loose connectors.
- Visual inspection of the ventilation and cooling systems to ensure correct functionality.
  - ✓ Liquid cooled systems should be checked for signs of leaks, loss of pressure and repaired/topped up as necessary.
  - ✓ Air cooled system checks should include filters, airflow, and dust depositing.
- Checks of any gas detection systems present for signs of damage, leaks, pressure reduction, or other performance issues.
- Thermographic cameras should be used to check for overheating or unusual hot spots and any issues raised with the maintenance company.
- Ensure general housekeeping arrangements meet expected standards.
  - ✓ Remove any combustible materials or waste from within BESS enclosures or within 10m of the installation.
  - ✓ Dust levels/accumulations should be monitored and BESS enclosures cleaned as necessary to ensure a sterile environment is maintained.
- Checks that there are no alarm or fault lights.

Note: The frequency of the above will be based on the exposure and nature of the installation but should be completed at least monthly.

Fire and Rescue Service

Invite the local Fire and Rescue Service to inspect the BESS to evaluate fire risk exposures and offer guidance.

- One of the most effective means of limiting the potential for fire spread from the enclosure to any other valuable assets in close proximity externally is to deploy firefighting hoses to create a 'water curtain', effectively cooling the area between the enclosure and the adjacent asset to help prevent radiated heat transfer. If this is pertinent to your site, this should be discussed during the Fire and Rescue Service visit.
- Consideration should be given to the containment of contaminated runoff firefighting water to limit the potential for expensive clean-up costs and pollution incidents.
  - ✓ The purchase of containment devices should be considered, along with storage arrangements, training, maintenance etc.

To support firefighting the water supplies available for Fire and Rescue Service use should be understood. Site management should therefore establish:

- What fire water is available.
- Static pressure flows and residual pressure test results.
- Whether additional resources, such as a private hydrant system or water storage tanks are necessary.
- The location and number of fire hydrants in the proximity of the BESS installation should be documented in an emergency response plan or shown on appropriate drawings.

Note: Minimum water supplies in excess of 1900 litres per minute for at least two hours are typically specified by Fire and Rescue Services in the United Kingdom, however this may not be sufficient, and consideration should be given to increasing the volume of stored water to supplement firefighting efforts if required.

Emergency Response

Given the risks associated with BESS/lithium-ion battery fires, an emergency response plan should be produced specifically developed to outline key responsibilities and actions in an emergency event.

The emergency response rules should be formally documented, and appropriate training provided.

Note: The explosive potential of lithium-ion batteries is increased when enclosed within compartments, particularly when oxygen levels increase suddenly, such as when compartment doors are opened. Access into such compartments during a fire event should ideally be limited to appropriately trained persons.

Impairments

Ensure any impairments relating to gas detection, monitoring systems and interlocks are reported to your Property Insurer and Insurance Broker. Temporary changes may be necessary to some arrangements whilst impairments are ongoing. Refer Aviva Loss Prevention Standard **Impairment Management** for further guidance.

Business Continuity

Every business should have a formal Business Continuity Plan in place. This should be reviewed to ensure disaster recovery and continuity arrangements remain adequate following the installation of the BESS. Any actions generated should be addressed promptly.

Security

- The BESS enclosure should be adequately secured to prevent unauthorised access. A strict authorisation procedure should be in place for persons requiring internal access to enclosures.
- All outdoor equipment cabinets for inverters etc., should be securely locked, and any switch/control panels also secured to prevent malicious interference.
- An assessment of the existing site security should be undertaken to evaluate the suitability of arrangements and whether any upgrades are necessary.
  - ✓ The BESS should not be freely accessible to members of the public and if this the case, security fencing with substantial physical security should be installed.
- Existing Video Surveillance Systems (VSS) VSS should be extended to cover the BESS.
- Should a new VSS be planned, specifications should be submitted to your Property/BESS Insurer and Broker for review.
- Cyber security exposures should be reviewed to ensure appropriate protections and procedures are incorporated including data access approval management.
  - ✓ Refer Aviva Loss Prevention Standard **Cyber Security - Top 12 Tips to Protect Against Cyber Attacks** for further guidance.

Key Action Steps

- Use reputable equipment and experienced/suitably trained installers.
- Discourage internally located BESS.
- Engage early in the design phase with your Property/BESS Insurer and Broker.
- Ensure gas detection systems, appropriate for BESS/lithium-ion batteries are installed and interlocked to isolate the BESS safely upon activation.
- Ensure appropriate deflagration/explosion venting is in place.
- Routinely check the BMS, controller and monitoring systems are fully functional with no faults or performance issues.
- Complete monthly self-inspections to ensure:
  - ✓ Equipment and charging locations are in good order (Use thermographic camera where appropriate).
  - ✓ Gas detection, monitoring and interlocks are in normal working order.
  - ✓ Housekeeping arrangements are satisfactory.
  - ✓ The BESS is adequately secured.
- Ensure preventative maintenance and servicing schedules are strictly adhered to and corrective actions are tackled promptly. Any faults or breakdowns should also be remedied promptly.
- Introduce emergency procedures and provide appropriate training to workers and other relevant persons such as visitors and contractors.
- Invite the local Fire and Rescue Service to site to familiarise themselves with the BESS and consider their emergency response and firefighting water runoff containment.
- Review Disaster Recovery and Business Continuity plans.

Checklist

A separate **Battery Energy Storage Systems Checklist** is available 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.

- Thermographic imaging and PAT testing: PASS
- Automatic fire detection and portable extinguishers: SECOM
- Business continuity: Horizonscan

For more information please visit: Aviva Risk Management Solutions – Specialist Partners

Sources and Useful Links

- EPRI BESS Failure Incident Database
- BS EN 62305 - Protection against lightning
- BS 7430:2011+A1:2015 Code of Practice for protective Earthing of Electrical Installations.
- MIS 3012 – The Battery Standard
- BS 7671: 2018 Requirements for Electrical Installations IET Wiring Regulations (18th Edition).
- UL 9540 Energy Storage Systems and Equipment
- UL 9540A Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
- BS EN IEC 62619:2022 Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications
- BS EN IEC 63056:2020 Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems
- BS EN 62620:2015+A1:2023 Secondary cells and batteries containing alkaline or other non-acid electrolytes. Secondary lithium cells and batteries for use in industrial applications
- NFPA 855 – Standard for the Installation of Energy Storage Systems
- NFPA 68 Standard on Explosion Protection by Deflagration Venting
- NFPA 69 Standard on Explosion Prevention Systems
- FM Property Loss Prevention Data Sheets 5-33 lithium-ion Battery Energy Storage Systems
- EN 13501-1 Fire classification of Construction Products and Building Elements - Classification Using Data from Reaction to Fire Tests
- BS EN 13501-2:2023 - Fire classification of construction products and building elements - Classification using data from fire resistance and/or smoke control tests, excluding ventilation services
- BS EN 14797:2006 Explosion Venting Devices
- FM 7730 Examination Standard for Explosion Venting Devices

Additional Information

Relevant Loss Prevention Standards include:

- **Grid Scale Battery Energy Storage Systems**
- **Battery Energy Storage Systems Checklist**
- **Business Continuity**
- **Contamination Following a Fire**
- **External Building Areas - Usage and Safety**
- **Fire Safety Inspections**
- **Heat and Smoke Venting Systems**
- **Managing Change - Property**
- **Smoke Contamination**
- **Thermographic Surveys**
- **Cyber Security - Top 12 Tips to Protect Against Cyber Attacks**
- **Cyber Security - Ransomware**

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

*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 A – Internal Battery Energy Storage Systems

Introduction

Siting a BESS internally, within an underground area e.g. car park or on top of a building should only be the last resort and requires very careful assessment, and a full understanding of all the exposures. Given the risks of significant damage and loss, any plans to install a BESS within, or on a building **must** be discussed with your Property Insurer/Broker.

The following points need to be carefully considered:

Fire Compartmentation. The BESS should only be housed in a dedicated fire compartment with at least 120 minutes fire resistance rating (insulation and integrity):

- ✓ This may need to be installed around and beneath the BESS if already in situ.
- Consideration should be given to maintaining the integrity of the fire compartment in respect of openings, pipework, ducting, services etc. and ensuring products such as fire shutters and fire stopping meet approval standards and are installed by suitable accredited and competent companies.
  - ✓ Refer to Aviva Loss Prevention Standards **Fire Compartmentation** and **Fire Doors, Shutters and Dampers** for guidance.
- External openings, such as windows etc., should be assessed and similarly protected if there is potential for vertical fire spread across the external fascia of the building or fire entering the building via other openings above; valuable and/or combustible infrastructure located directly adjacent; or life safety concerns such as public highways, fire escape routes in proximity, as stipulated in the premises Fire Risk Assessment.
- The BESS compartment should not be used for any other purpose and a clear distance maintained around the fire compartment and its openings of at least five metres is recommended.
  - ✓ Marking the flooring to specify clearance distances is recommended where possible.

Ventilation. In addition to any systems installed to the BESS, active ventilation and explosion relief systems are likely to be necessary within the fire compartment. This should be assessed by a suitably competent person or consultant within an explosion assessment, and any recommended actions implemented.

Fire Detection. The buildings automatic fire detection system should be extended to the BESS compartment and interlocked to the power supply and charging systems to isolate upon activation.

- Alarms associated from the above should raise a site fire alarm, or monitoring alarm, to ensure there is an immediate emergency response and escalation if needed. Appropriate training should be provided on safe isolation of equipment.
- If not already in place you may wish to consider connecting the alarm to a constantly attended location or an approved Alarm Receiving Centre. An accredited fire alarm installer can provide further guidance.

Fire Protection. Guidance on active fire protections within the compartment housing the BESS should be sought from your Property Insurer/Broker to ensure compatibility with the particular risk features that are or will be present including the BESS equipment itself and battery types, compartmentation standard and construction, general occupancy and trade activities, and ventilation systems.

Temperature. The maximum room temperatures should be assessed, and cooling/heating systems configured to automatically operate prior to recommended battery temperature thresholds being met.

- Automatic heating/ cooling systems should be suitable for use in potentially explosive environments and be subject to routine testing to ensure safe operation when required.

Gas detection. If the BESS itself is not fitted with a suitably fire/explosion rated gas detection system, this should be installed within the compartment, and interlocked to the power supply and charging systems to isolate upon the immediate detection of gases and prior to thermal runaway.

Humidity. Minimise the humidity within the storage area/building to meet the requirements of the stored batteries/cells.

Please Note

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