Grid-Scale Battery Energy Storage Systems – Ongoing Care

This Loss Prevention Standard is one of a series of documents covering Grid-Scale Battery Energy Storage Systems (BESS), providing guidance on self-inspection regimes, maintenance programmes and ongoing care to help reduce the risks of loss or damage associated with these systems.

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Introduction

Aviva Loss Prevention Standard **Grid-Scale Battery Energy Storage Systems - General Considerations**, the first in a series of documents covering grid-scale BESS, provides an overview of the main activities, equipment, and design considerations, whilst **Grid-Scale Battery Energy Storage Systems - Construction** provides useful guidance on constructing grid-scale BESS to a standard that reduces the potential for loss or damage.

This standard provides guidance in relation to the ongoing care and maintenance of the BESS and other associated equipment, including detection and fire protection systems.

Note: This document is focussed on property loss prevention in relation to liquid electrolyte battery BESS installations and related risk management guidance. It is not intended to address liability exposures. The presumption is that all regulatory requirements, Fire Risk Assessments, and compliance with requirements placed by the local authority having jurisdiction which would include licensing, building permissions, regulations, codes, or standards, have or will be met.

Understanding the Risks

Poor ongoing care and maintenance can increase the risks of loss or damage. For example:

- **Fire**. Potential causes of fire damage include:
  - ✓ **Battery Fire**. Most BESS utilise lithium-ion batteries, which can age, become damaged during use or develop faults, all of which can lead to instability. Damaged batteries can release toxic and explosive gases and eventually ignite. The consequences of a fire or explosion involving lithium-ion batteries can be significant:
    - Lithium-ion battery fires are very difficult to extinguish. Fire can sustain over long periods of time as it spreads between individual cells within the battery modules. Once extinguished, batteries can reignite as a result of ongoing chemical battery decomposition. The ferocity of lithium-ion battery fires can help spread fire between adjacent enclosures, buildings and other assets.
    - Combustion products are highly damaging, corrosive, and can damage undamaged components within the enclosure, and other buildings, assets, etc., in proximity.
    - Highly flammable gases accumulating within enclosures can deflagrate /explode.
  - ✓ **Electrical**. Damaged and/or faulty electrical components and equipment and overloaded systems can lead to electrical fires and downtime for repairs.

- ✓ **Hot Works**. Poorly managed hot works within or in proximity to BESS enclosures can result in ignition or smoke damage to components, combustible materials, nearby vegetation, etc.
- ✓ **Windstorm**. Damaged foundations can increase BESS vulnerability to wind damage, as can damaged vents, hatches and other openings. Unsecured items, stored materials and equipment, etc., can also become windblown and cause damage to BESS enclosures and associated equipment.
- ✓ **Flooding**. Sites can be damaged by high water levels whether by contaminated water or humidity damage to sensitive components.

Managing the Risks

Maintenance

- All BESS equipment including batteries, cooling, and ventilation, BMS, controller systems and monitoring systems along with associated equipment such inverters, transformers, gas detection systems, fire detection systems, lightning protections, security protections and systems, etc., should be maintained in accordance with Original Equipment Manufacturer (OEM) and/or system installer guidelines and instructions.
  - ✓ BESS Servicing and maintenance should be undertaken in accordance with the manufacturers recommendations, typically performed twice yearly or annually by competent and experienced contractors or companies.
  - ✓ Planned preventive maintenance regimes outlined by the manufacturer may be supplemented using BMS analytics to identify opportunities for strategic additional maintenance to prolong component lifespan.
- The BESS maintenance company, using manufacturers' guidance and performance data will replace aged or degrading components as part of the formal maintenance programme.
  - ✓ Any damaged or faulty 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.

Refer to Aviva Loss Prevention Standards **Maintenance Regimes** for further guidance.

Self-Inspections

In addition to servicing and maintenance, regular visual inspections need to be completed for signs of wear, tear, damage, cooling system leaks, water ingress, etc. To help support this, the self-inspections should include:

- External inspection of BESS enclosure, including openings vents, footings, security locks, protective seals, etc.
- External checks of the cabling systems, Power Conversion Systems (PCS) including inverter(s), and MV 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 or topped up as necessary.
  - ✓ Air cooled system checks should include filters, airflow and dust deposits.
- Checks of gas and fire detection systems and automatic fire suppression systems present for signs of damage, leaks, pressure reduction, or other performance issues.
- Checking that interlocks associated with the above are fully functional.
- The use of thermographic cameras to check for overheating or unusual hot spots and any issues raised with the maintenance company.
- The use of acoustic imaging cameras to help identify leaks in liquid cooling systems.
- Inspection of lightning protection systems to ensure they are undamaged and in good working order.
- Ensuring general housekeeping arrangements meet expected standards.
  - ✓ Remove any combustible materials or waste from within BESS enclosures or within 10m of the installation.
- Routinely check the BMS, controller and monitoring systems are fully functional with no faults or performance issues.
- Checks for any other alarm or fault lights.
- Inspection of substation/switchgear buildings, removing any unauthorised storage and checking for damage, faults, evidence of faults, etc.
- Checks of security protections and systems, including cyber security, for evidence of breaches and tampering. Ensure any identified issues are actioned promptly.

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

The Aviva Loss Prevention Standards **Housekeeping - Fire Prevention** and **Self-Inspections** provide useful guidance in this regard.

Emergency Response

- The Emergency Response Plan should be reviewed at least annually to ensure it remains adequate and sufficient.
- The list of responsible persons and roles named in the Plan should be checked and updated to reflect any changes in personnel.
- Practice drills should be carried out at least annually incorporating various risk events.
- Lessons learned exercises should be carried out after such exercises and any risk or near-miss risk events to support continual improvement.

Refer to Aviva Loss Prevention Standard **Emergency Response Teams** for further guidance.

Business Continuity

The Business Continuity Plan should be reviewed at least annually to account for any changes to the site, changing marketplace conditions, personnel changes, etc. Any actions generated should be addressed promptly.

Refer to Aviva Loss Prevention Standard **Business Continuity** for further guidance.

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Additional Information

Relevant Aviva Loss Prevention Standards include:

- **Grid-Scale Battery Energy Storage Systems – General Considerations**
- **Grid-Scale Battery Energy Storage Systems – Construction**
- **Battery Energy Storage Systems Checklist**
- **Small-Scale Battery Energy Storage Systems**
- **Hot Work Operations**
- **Thermographic Surveys**
- **Business Continuity**
- **Emergency Response Teams**
- **Housekeeping – Fire Prevention**
- **Maintenance Regimes**
- **Self-Inspections**
- **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.**

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