

Low Voltage BESS Design

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Revision History

This amendment is the initial release.

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1 Purpose

This standard sets out the design requirements for Pole Mounted and Ground Mounted Low Voltage (LV) Battery Energy Storage System (BESS) installations to improve network utilisation, reliability and quality of supply. The standard ensures consistent application, standardisation, and effective risk mitigation.

2 Scope

This standard is applicable to all LV BESS installations within Endeavour Energy franchise and configured to operate in either configuration outlined below:

- **Network Support BESS** are deployed solely to address local network requirements, such as peak demand reduction, mitigation of forecast overloading, improvement of solar hosting capacity, or resolution of local quality of supply issues.
- **Community Battery BESS** are metered LV BESS installations that, in addition to providing Network Support when required, allow a retail partner to utilise available battery capacity for participation in the National Electricity Market (NEM) wholesale markets. Retail partners may also offer customer incentives to encourage participation in Community Battery programs.

3 References

External Regulations		
ENA National Guidelines for Distribution Network Service Provider-owned Battery Energy Storage System (DOC 054-2025)		
Service and Installation Rules of NSW		
NSW EPA Noise Policy for Industry (2017)		

External Standards		
Standard No.	Year	Title
AS 3000	2018	Electrical Installations 'Wiring Rules'
AS 3008.1.1	2025	Electrical Installations – Selection of Cables
AS 4777.1	2024	Grid connection of energy systems via inverters – Installation Requirements
AS 5139	2019	Electrical Installations – Safety of Battery Systems for use with power conversion equipment
AS 61439.1	2026	Low Voltage Switchgear and Control Assemblies General Rules

Company Policies and Procedures

Company Policy 9.2.5 - Network Asset Design
Environmental Guidelines Handbook

Company Standards

Mains Construction Instruction MDI 0005	Overhead construction standards manual
Mains Design Instruction MDI 0011	Underground distribution cables – continuous current ratings
Mains Design Instruction MDI 0028	Underground distribution network design
Mains Construction Instruction MDI 0006	Underground distribution Construction standards manual
Mains Design Instruction MDI 0030	Method of calculating voltage drop in low voltage mains
Mains Design Instruction MDI 0031	Overhead line design
Mains Design Instruction MDI 0042	Overhead conductor ratings
Mains Design Instruction MDI 0043	Grid connection of embedded generation through inverters
Mains Design Instruction MDI 0044	Easements and Property Tenure
Earthing Design Instruction EDI 0006	Earthing construction standard
Environmental Management Standard EMS0001	Environmental impact assessment and environmental management plans
Standard Asset Data SAD 0001	Project Drawing Standard
Substation Design Instruction SDI548	EcoJoule EcoStore Low Voltage Pole Battery Manual
Substation Design Instruction SDI549	Rolls Royce MTU Low Voltage Ground Battery Manual
Substation Design Instruction SDI551	Pixii PowerShaper Low Voltage Ground Battery Manual

4 Definitions and Abbreviations

Term	Definition
BESS	Battery Energy Storage System
Bush fire Prone Land (BFPL)	Bush fire prone land (BFPL) is land that has been identified by local council which can support a bush fire or is subject to bush fire attack. Bush fire prone land maps are prepared by local council and certified by the Commissioner of the NSW RFS.
FLOC	Functional Location references the location where an asset is installed.
FRNSW	Fire and Rescue NSW

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LV	Low Voltage (LV) is defined as a nominal voltage exceeding 50 V AC but not exceeding 1000 V AC
MCI	Mains Construction Instruction
MDI	Mains Design Instruction
NFPA	National Fire Protection Association
SIRs	Service and Installation Rules

5 Actions

5.1 General Requirements

LV BESS systems and installations must be designed and installed in accordance with AS 3000, SIRs, AS 61439 and this standard.

For details on specific LV BESS systems refer the relevant SDI.

5.1.1 Site Selection

Potential Sites for LV BESS Units shall be identified by Future Networks and Markets team and assessed for their value to the Endeavour Energy network. This assessment shall consider factors such as:

- the quality of supply (voltage constraints) as a result of rooftop solar and household battery penetration in the area.
- demand profile of the distribution substation where the LV BESS will be connected to.
- Feeder constraints.

A thorough technical desktop assessment must be undertaken by the designer to evaluate each site for feasibility. This assessment shall consider the following criteria to identify a suitable location:

- Areas of public space (e.g. SP2 Infrastructure zones, parks, and sports fields) and industrial zones that may be suitable sites.
- The requirements of the Endeavour Energy Environmental Guidelines Handbook.
- 1 in 100-year AEP Flood levels
- 3rd Party Stakeholders (Overhead Communications Network, Other Overhead Electricity Network, Road Classification & High-Risk Underground Services)
- Easement requirements and potential availability.
- Existing LV Network (DSUB Size, Cable/Conductor Suitability, Customer Numbers, Existing PV Count).
- 4G Network Coverage.
- Exposure to vandalism.

Sites which are found to be technically feasible are then reviewed for the level of customer impact which determines the merit of the site proceeding to stakeholder consultation. This review process shall be undertaken by Future Networks and Markets and Corporate Communications. Sites endorsed by internal stakeholders and assessed as high suitability shall progress to project stage and be sent to Engineering Design for detailed design.

5.1.2 Fire Safety and Emergency Considerations

Due consideration shall be given to adequately protecting against high temperatures, water ingress, electrical abuse, and impacts from vehicles. Units shall be adequately ventilated to prevent fume and gas build-up.

Additionally, the following design considerations are recommended:

- A minimum of 2m away from vents, air intakes and openings such as windows and doors
- Within 60m of an operational fire hydrant.
- Away from areas sensitive to contaminated firefighting water run-off.

5.1.2.1 Emergency considerations

The designer shall consider the following for all LV BESS installations:

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- **Signage:** Fitted with appropriate hazardous chemical, electrical and emergency signage in accordance with relevant Australian Standards,
- **FRNSW notification:** Detailed emergency and response information shall be provided to Fire and Rescue NSW (FRNSW). All LV BESS installation locations shall be provided to FRNSW.
- **Monitoring:** Systems requiring firefighting intervention should include automatic detection and notification to emergency services.

5.1.3 Earthing Requirements

AS 3000 Requirements shall be used for all “Community Batteries” which includes:

- 12mm Diameter Copper Clad Electrode installed to a minimum depth of 1.2m to be used.
- Connection point of Main Earth Cable to Electrode to be accessible within a pit.
- Main Earth Cable to be connected between the main electrode and main earth bar.
- Main Earth Cable to be labelled “Main Earth Connection, do not disconnect”.
- The location of the Main Earth Electrode to be identified within the switchboard.
- An MEN Link must be installed between the main earth bar and main neutral bar.

Network Support BESS shall use LV Earthing arrangements specified on the Standard Drawing for Gen 1 units and drawing 531471 for Gen 2 units in conjunction with EDI 0006 Earthing Construction Standard.

Note: Manufacturers specific requirements should also apply as follows:

- RR MTU requires 2 x additional 95mm² Cu earth cables connected to the external housing at two different grounding points diagonally opposite in addition to the BESS Circuit Earth.
- EcoJoule BESS requires a minimum 6mm² Cu main earth cable and BESS circuit earth cable.

5.2 Ground Mounted LV BESS Units

5.2.1 Location and Access

Ground Mounted LV BESS units shall adhere to the same requirements as padmount substations as outlined in MDI0028 clause 6.3.2 Substation access and MCI0006 clauses 7.1.2.2 Personnel Access, 7.1.4 Protection from Vehicles and 7.1.6 Flooding and Drainage. The basic requirements are:

- Units shall generally be located at the front and inside the property boundary with unrestricted 24 hour per day personnel and vehicle access to the BESS unit directly from a public street. Where suitable, units are permitted to be located in open public spaces such as parks.
- Units must not be located within 6 metres of road intersections, including roundabouts, or curved sections of the carriageway to reduce the risk of vehicle impact damage. The 6m shall be measured from the property boundary vertex preceding the straight section of the road reserve.
- Units shall be located safely; where required bollards or safety rails shall be erected to protect staff.
- Additional consideration must be given for locating Ground Mounted LV BESS units so that will not be subject to damage by vehicles. Examples include carpark.
- Personnel access route to the unit must be at least 1.2m wide.
- An aisle shall be no smaller than 750mm wide and areas for evacuation shall be no less than 600mm wide even whilst removable parts are in position or with doors open.
- Where fall hazards exist, stairs and handrails shall be installed.
- As a minimum, the level at the top of the BESS unit footing shall not be lower than the 1:100 year flood level.
- Installation of Ground Mounted LV BESS units in Bushfire Prone Land (BFPL) shall be avoided. Proposals to install Ground Mounted BESS units in Bushfire Prone Land (BFPL) should be assessed in consultation with the Manager, Asset Integrity & Maintenance and Reliability & Resilience Manager.

5.2.2 Segregation Requirements

5.2.2.1 Screen wall and barriers

Screen walls installed for the purpose of achieving segregation risk reduction for noise, blast and fire and the like from LV BESS installations must be approved by the local council or other relevant body in accordance with clause MCI0006 2.6. The screen walls must be located outside the easement and wholly within the one single property boundary. In determining the length and location of any screen wall, guaranteed setbacks as determined in the Development Application may be used. Refer to MDI0044 – Easements and Property Rights for the requirements of Restrictive Covenants required to be placed onto any screen walls.

5.2.2.2 Fire segregation

Ground-mounted LV BESS units must be separated from vegetation, stored combustibles, neighbouring areas and buildings subject to fire risk. This separation must be achieved by either:

- **Physical Clearance:** A minimum 3m separation distance.
- **Fire Barrier:** Where 3m clearance is unachievable, a fire screening wall or barrier with a minimum 120/120/120 FRL must be installed, in accordance with MDI 0028 Clause 6.3.13 (for padmount substations).

All mitigation measures must satisfy the requirements of NFPA 855.

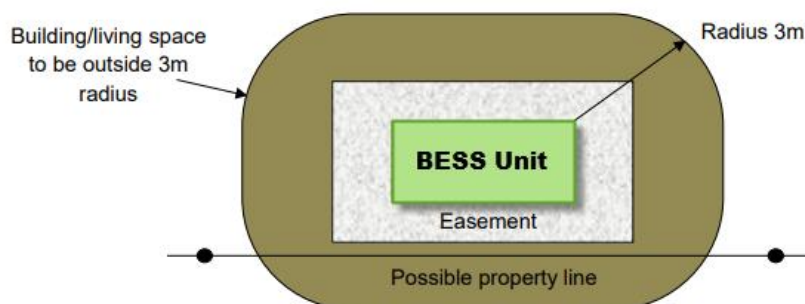


Figure 1: Minimum clearance to building/living areas

5.2.2.3 Noise segregation

Segregation of Ground Mounted LV BESS units to residential receivers shall comply with EPA Noise Policy for Industry (NPI). A noise assessment must be undertaken to show compliance.

The required separation may be reduced through additional noise attenuation, provided an independent noise assessment confirms the installation to be below EPA NPI Guidelines, with in-field verification of actual noise levels conducted once the installation is complete.

Note: The clearances outlined below must be achieved for the following Ground Mounted LV BESS units:

- RR MTU – 15m from the residence.
- Pixii Power Shaper 2.0 – 8m from the residence
- Pixii Power Shaper XD – 10m from the residence

These separations could be reduced with the use of additional noise attenuation, and an independent noise assessment determines the installation to be below EPA Guidelines.

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5.2.3 Easements and Tenure

New Ground Mounted LV BESS units shall be installed within public land as the preferred option. In situations where they are installed in any location other than public land, an easement benefitting Endeavour Energy, or legally equivalent status, shall be granted to Endeavour Energy to retain, maintain and operate all network assets installed in that land, without restrictions. Requirements shall be as per MDI 0044 Easements and property tenure.

Note: The minimum easement size outlined below must be achieved for the following Ground Mounted LV BESS units:

- RR MTU – 4.8m x 5.5m

5.2.4 Site contours and retaining walls

The easement represents the minimum working area required for normal operation of the BESS unit and the following requirements must be adhered to: (Refer MCI 0006 7.4.2)

- BESS unit site shall be flat and level over the entire easement area.
- If excavation is required to level the site, the batter adjacent shall be no steeper than 1 in 3 for at least 1m outside the easement.
- Where a step is used adjacent and outside the easement the maximum step size (up or down) permitted is 300mm in each 1000mm.
- Retaining walls should only be used when absolutely necessary. Retaining walls may be up to 700mm in height constructed from non-combustible materials such as concrete or brick but not treated pine. Where required, they must be constructed outside the standard easement. For drops greater than 300mm a hand railing must be installed unless otherwise approved by the Asset Engineering Manager. All retaining walls must be approved in accordance with MCI0006 Clause 2.6 as required by the relevant codes and local government requirements.

5.2.5 Foundation Requirements

The BESS unit site is required to be stable and clear of any obstructions that could interfere with the installation of the foundation.

Note: For existing Ground Mounted units in Endeavour Energy's network see the following drawing(s):

- Drawing no. 529763 details a poured slab design for RR MTU units.

This drawing provide a suitable foundation provision for the switchboard.

5.2.6 Switchboard

Switchboards must be designed to be installed on a concrete foundation in a suitable location near the Ground Mounted LV BESS. Switchboard to be designed to suit LV BESS installation.

5.2.7 Isolation Points

Ground Mounted BESS units must be designed with multiple points for electrical isolation as detailed below:

- A Circuit Breaker (CB/MCB) rated as required within the LV Switchboard distribution section, protecting the BESS unit circuit as per AS3000 requirements.
- A Service Protective Device (SPD) rated as required within the LV Switchboard, protecting the BESS installation. As per Service and Installation Rules of NSW requirements. This isolation also satisfies the requirements of the Electrical Safety Rules.

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- An additional network isolation point must be installed ideally ≥ 5 metres away from the BESS unit, this isolation point can be used if a situation arises making it unsafe to isolate at the SPD. Suitable options are below:
 - A dedicated fuse strip within a PM Substation when connected to UG network.
 - LV Links installed within a pillar when connected to UG network.
 - LV Links installed on a pole when connected to OH network.

This additional switch must be installed in a manner to not isolate other equipment or customers.

A label shall be installed on the isolation Pillar clearly indicating the location of "Isolation Links for BESS". Additional labelling at the associated LV Distributor Fuse and/or DSUB indicating a connected LV BESS is also recommended.

5.2.8 GIS and GISCAD Symbology

The following symbols for Ground Mounted LV BESS units in Table 1: Ground Mounted LV BESS GIS & GISCAD Symbology shall be used on project drawings and GIS.

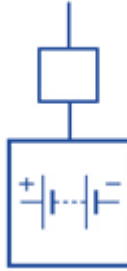
Feature	Symbol
GIS Geographic Window Ground (UG) Battery And GISCAD Symbol	
GIS Detail Window Battery	

Table 1: Ground Mounted LV BESS GIS & GISCAD Symbology

5.2.9 SAP Asset Numbering Requirements for Ground Mounted LV BESS units

The Ground Mounted LV BESS unit and Isolation Point will have SAP numbers created and shall have Functional Location (FLOC) hierarchy as shown in Figure 2: SAP Structure for a LV Ground Mounted BESS below.

FLOC numbers are related to the location where an asset is located, Equipment installed at these locations will have separate unique equipment numbers issued in SAP. An equipment number in SAP is related to the physical asset in the field such as an LV pillar cubicle.

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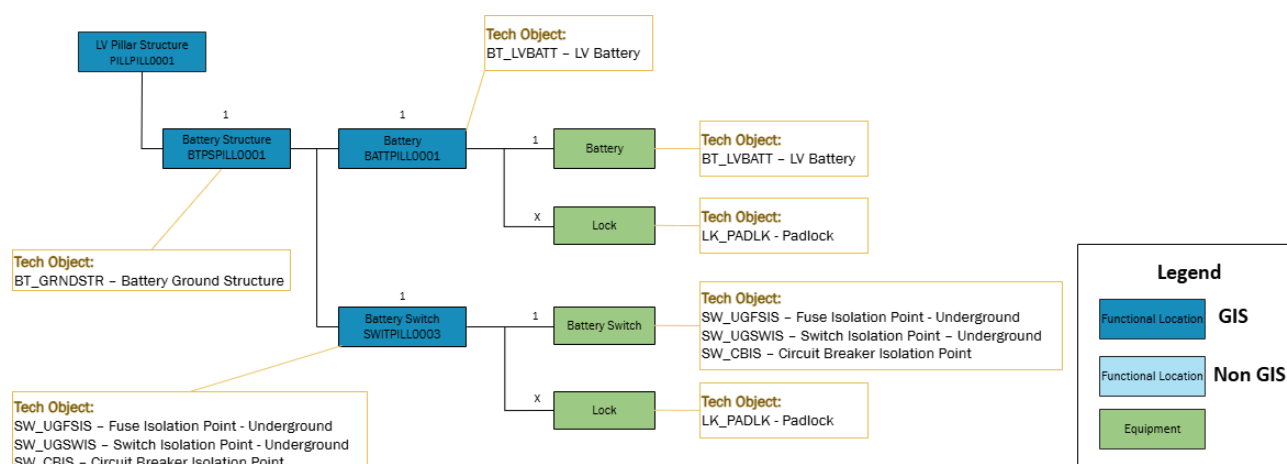


Figure 2: SAP Structure for a LV Ground Mounted BESS

The FLOC number shall be affixed to the assets in accordance with the requirements of MCI 0006 clause 3.3 where applicable. The asset numbers for the equipment are not required to be affixed to the equipment.

5.2.10 Service mains

All cables shall be sized to meet current and voltage drop requirements as specified in AS 3008

Service Mains Cable length must be $\leq 50\text{m}$ as per Service & Installation Rules NSW. Refer to SIRs for further information.

Note: The below item is relevant to current Ground Mounted LV BESS units being installed by Endeavour Energy and is provided as general guidance only:

- Service Mains Cable for 400A installations (ie. 200kW MTU) min 240mm² Cu.

5.2.10.1 Restrictions on new services from BESS nodes

No services are permitted on the Ground Mounted LV BESS side of LV pillars associated with the installation.

The following labels are required:

Label Type	Label	Material No.
Single switch pillars	NO services to be connected on the BESS side of the links	1000010250
3-way switches	No services to be connected on BESS switch	1000010212

5.3 Pole Mounted LV BESS Units

5.3.1 Location and Access

Pole Mounted BESS units shall be designed in accordance with requirements for single pole substations as outlined in MDI0031 clauses 3.24, 3.24.2, 8.1.4.2 and MCI0005. The following requirements apply:

- Pole BESS units must be installed in readily accessible locations, meeting all requirements for safe electrical clearance. Units shall not be installed:
 - Near corners or tee intersections
 - On excessively sloping embankments that prevent normal access.
 - On islands between roads.
- Pole BESS units shall be mounted on poles with minimum strength of 8kN. Refer to relevant SDI for further detail.
- Pole BESS units shall have unrestricted 24-hour personnel and plant access from a public street.
- Pole BESS units shall be located within the footpath allocation of the road reserve where possible.
- Pole BESS units are permitted to be located in open public spaces such as parks.
- Pole BESS units shall be located as to minimise the risk of vehicle impact.
- Installation of Pole Mounted BESS units in Bushfire Prone Land (BFPL) shall be avoided. Proposals to install Pole Mounted BESS units in Bushfire Prone Land (BFPL) should be assessed in consultation with the Manager, Asset Integrity & Maintenance and Reliability & Resilience Manager.
- Pole BESS units shall be designed on their own dedicated pole a suitable distance away from existing overhead mains, this is to avoid significant network impact in the unlikely event of Battery Fire.
- Service Cables and Small Streetlight equipment may be installed on the BESS pole provided they use an independent LV Supply.

The New Pole Mounted BESS should generally be designed in accordance with MDI0031 and MCI0005.

5.3.2 Segregation Requirements

5.3.2.1 Fire segregation

Pole BESS units must maintain a minimum of 3-metre horizontal clearance zone around the pole to minimise the effects of failure of equipment in accordance with Figure 3: Fire and noise separation.

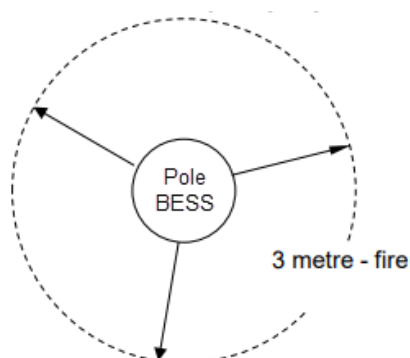


Figure 3: Fire and noise separation

5.3.2.2 Noise segregation

Pole Mounted LV BESS unit sites shall comply with the requirements of the EPA Noise Policy for Industry and may require a noise assessment to be undertaken.

Separation may be reduced with the use of additional noise attenuation, and an independent noise assessment determines the installation to be below EPA Guidelines, with in-field verification of actual noise levels conducted once the installation is complete.

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Note: The following general guidelines for apply for existing Pole Mounted LV BESS units in Endeavour Energy's network:

- EcoJoule - EcoStore – 4m (Urban) and 8m (Rural) from the residence.

5.3.3 Easements and Tenure

New Pole Mounted LV BESS assets shall generally be installed within public land. Where Pole Mounted LV BESS are proposed for any location other than public land, an easement benefitting Endeavour Energy, or legally equivalent status, shall be granted to Endeavour Energy to retain, maintain and operate all network assets installed in that land, without restrictions. Requirements shall be as per MDI 0044 Easements and property tenure.

5.3.4 Switchboard

A Single Line Diagram must be completed by Endeavour Energy Design.

When a LV BESS unit is installed as a “Network Support”, a distribution board and enclosure is the only switchboard required. Switchboards shall be pole-mounted and be installed on the LV BESS unit pole directly below the unit. Refer to the relevant SDI for further information.

Note: A Distribution Board and Enclosure has been developed for use on Pole Mounted LV BESS Units to facilitate termination of the flexible cables supplied with the EcoJoule LV BESS units. This Distribution Board and Enclosure has been developed with “Wise Energy” and can be ordered through SAP Material No.1000009515.

Important: At this time Pole Mounted “Community Batteries” require a dispensation from the Service and Installation Rules of NSW to:

- Install a main switchboard on an EE Network Pole
- Install an SPD and Metering Equipment >2m above ground level.

This dispensation is to be sought through the Asset Engineering Manager with endorsement from the Customer Connections Manager and should cover all proposed Pole Mounted “Community Batteries”.

5.3.5 Isolation Points

Pole Mounted BESS units shall be designed with multiple points for electrical isolation as detailed below:

- **‘Network Support’**
 - A Circuit Breaker (MCB) rated as required within the LV Distribution panel, protecting the BESS unit circuit.
 - Fuses rated as required within the LV Distribution panel. These fuses satisfy the requirements of the electrical safety rules.
- **‘Community Battery’**
 - A Circuit Breaker (MCB) rated as required within the LV Distribution panel, protecting the BESS unit circuit. (AS3000)
 - Fuses rated as required within the LV Distribution panel.
 - A Main Switch within the LV Meter/Switchboard (AS3000)
 - Services Fuse within the LV Meter/Switchboard (Service & Installation Rules NSW). The service fuses satisfy the requirements of the electrical safety rules.

An additional network isolation point must be installed away from the pole BESS unit. This isolation point provides a safe alternative if it becomes unsafe to isolate at the Community Battery SPD or the Network Support Main Isolator. Suitable options are below:

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- Overhead LV Links installed at the pole where the Overhead Mains to the BESS unit connects to Main Overhead LV network.

This additional switch must be installed in a manner to not isolate other equipment or customers.

A label must be installed on the isolation clearly indicating them as “Isolation Links for BESS”.

Additional labelling at the associated LV Distributor Fuse and/or DSUB indicating a connected LV BESS is also recommended.

5.3.6 GIS and GISCAD Symbolology

The following symbols for Pole Mounted LV BESS units in Table 2: GIS and GISCAD Symbolology shall be used on project drawings and GIS.

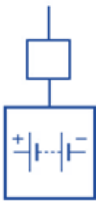
Feature	Symbol
GIS Geographic Window Pole (OH) Battery And GISCAD Symbol	
GIS Detail Window Battery	

Table 2: GIS and GISCAD Symbolology

5.3.7 SAP Asset Numbering Requirements for Pole Mounted LV BESS units.

The Pole Mounted LV BESS unit and Isolation Point will have SAP numbers created and shall have Functional Location (FLOC) hierarchy as shown in Figure 4: SAP Structure for a Pole Mounted LV BESS below.

FLOC numbers are related to the location where an asset is located, equipment installed at these locations will have separate unique equipment numbers issued in SAP. An equipment number in SAP is related to the physical asset in the field such as a wood pole.

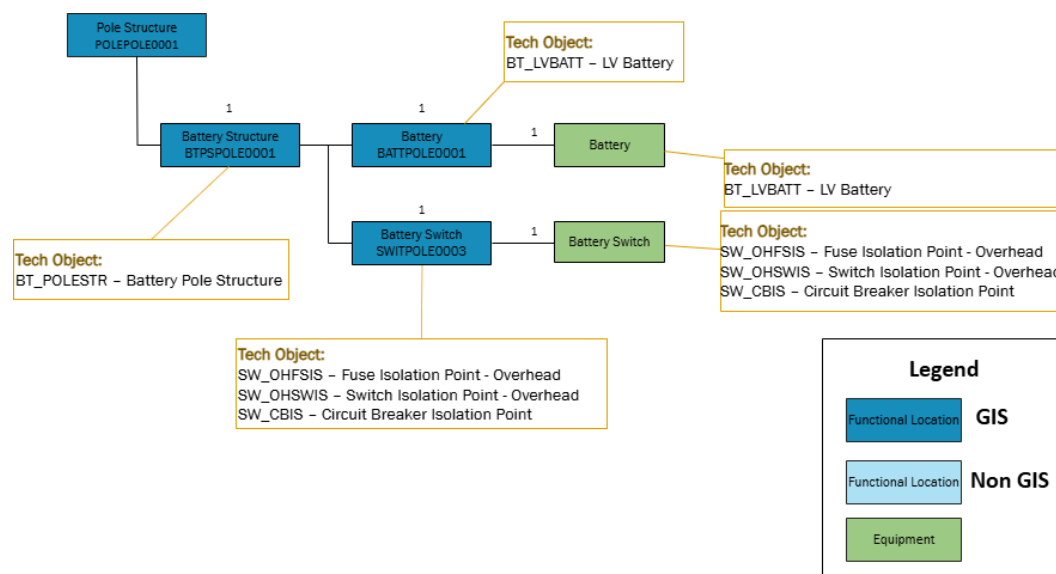


Figure 4: SAP Structure for a Pole Mounted LV BESS

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The FLOC number shall be affixed to the assets in accordance with the requirements of pole substations in MCI 0005 clause 3.4 where applicable. The asset numbers for the equipment are not required to be affixed to the equipment.

5.3.8 Service mains

All cables shall be sized to meet current and voltage drop requirements as specified in AS 3008 Electrical Installations – Selection of Cables.

Note: The below items are relevant to current Pole Mounted LV BESS units being installed by Endeavour Energy and is provided as general guidance only.

- The overhead service must be $\leq 50\text{m}$ as per Service & Installation Rules NSW. Refer to SIRs and MCI 0004 for further information.
- Service Mains Cable for 100A installations (ie. 1 x 40kW EcoJoule) min 25mm² Al
 - Current designs are using 95mm² Al LVABC
- Consumer Mains Cable for 100A installations (as above) min 16mm² Cu

5.3.9 Restrictions on Mains extension or new services from BESS nodes

Pole Mounted LV BESS are generally installed on dedicated poles and supplied by dedicated service mains only.

No mains extension is permitted on from this service. Additionally, no new service connections are permitted from this service main.

The following labels are required:

Label Type	Label	Material No.
On poles	NO mains extension or new service connections from the dedicated cable supplying the BESS unit	1000010250

6 Authorities and Responsibilities

Listed below are the positions or groups of positions that have specific authorities and responsibilities associated with this standard.

General Manager Future Grid and Asset Management has the authority and responsibility for:

- approving major changes to this instruction in accordance with ENG 0002;
- making all decisions concerning compliance with this instruction;
- delegating any of these authorities and responsibilities to the Head of Asset Management and Digital.

Head of Asset Management and Digital has the authority and responsibility for:

- approving minor changes to this standard in accordance with ENG 0002;
- Making recommendations to the General Manager Future Grid & Asset Management for major changes in respect to this standard.

Manager, Asset Engineering has authority and responsibility for:

- reviewing this technical specification for suitability in Endeavour Energy's network;
- making recommendations to the Head of Asset Management and Digital based on industry best practice;
- managing dispensation requests for variations to requirements of this instruction.

Manager Future Grid Strategy has the authority and responsibility for:

- approves list of potential sites for a battery installation after technical assessment by Future Grid Engineer or Lead Engineer before providing the list to Engineering Design for technical desktop assessment.
- making recommendations to the General Manager Future Grid & Asset Management for major changes in respect to this standard.

Manager, Asset Integrity and Maintenance has the authority and responsibility for making recommendations for potential sites for LV BESS installation located in Bushfire Prone Land.

Reliability & Resilience Manager has the authority and responsibility reviewing Bushfire risk for potential sites for LV BESS installation located in Bushfire Prone Land.

Environmental Services Manager has the authority and responsibility for provision of advice relating to site environmental impact assessment, environmental approvals and management of environmental operational risks (such as noise and vibration) associated with the construction and installation of BESS.

