

Pixii 'PowerShaper' Low Voltage Ground Battery Manual

Design, Installation, Operation, Maintenance
Commissioning and Emergency Response

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Version History

Version	Revision Date	Revision By	Details
0	02/04/2024	M.Ikoro / M. Adair	Initial issue.
1	07/05/2024	M. Adair / M. Ikoro	Document revised based on feedback from battery review panel.
2	21/06/2024	M. Adair / M. Ikoro	Revisions to responsibilities and accountability in confirming location. Revisions to centralised protection. Revisions to transformer monitoring. Revisions to transport and storage requirements. Revised responsibilities on data capture and validation. Updated link to commissioning register. References to standard drawings removed – refer to site specific detailed designs.
3	09/09/2024	M. Ikoro	Revision for permanent DSub monitors to be installed at the substation LV bus (Page 14) Revision for Centralised protection (Page 17)
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1. Preamble

Following internal consultation, information and instructions related to the Pixii “PowerShaper” LV battery systems shall be included within this manual until a level of maturity and confidence on deployment has been reached. At this point, it is proposed that the updated content is formally published within standards, procedures, and workplace instructions.

2. Purpose

The purpose of this manual to provide information and instruction related to the design, installation, operation, commissioning, and emergency response applicable to Pixii ‘PowerShaper’ LV ground batteries to be deployed for the application of network support on Endeavour Energy’s distribution network.

- Specific content covered within this document includes:
- LV Battery product identification codes
- Technical specifications
- Installation and construction methods
- Operational requirements
- Maintenance requirements
- Emergency response requirements

3. References

External Regulations

Australian Dangerous Goods Code 2022 Edition 7.8

NSW Work Health and Safety Act 2011

NSW Work Health and Safety Regulation 2017

External Standards

AS/NZS 3000 - Electrical Installations – Wiring Rules

AS/NZS 4777.1:2016 – Inverter Installation Requirements Standard

AS/NZS 4777.2:2020 - Inverter Requirements standard

AS/NZS 5139:2019 - Battery Energy Storage System Installation requirements

AS/NZS 62477.1:2016 - Safety requirements for power electronic converter systems and equipment

IEC 62619:2022 - Safety requirements for secondary lithium cells and batteries, for use in industrial applications

AS/NZS 61000.3.12:2013 – Limits for harmonic currents produced by equipment connected to public low-voltage systems

AS/NZS 60529:2004 – Degrees of protection provided by enclosures (IP Code)

Company Policies and Procedures

Company policy 9.1.7 – Commissioning Network Electrical Assets

Company Policy (Network) 9.2.5 – Network Asset Design

Company Policy (Network) 9.7.1 – Network Asset Construction

Company Policy (Network) 9.8.3 – Network Operations

Company Policy (Network) 9.9.1 – Network Asset Maintenance

EDI 100 – Earthing Design Instruction	Distribution earthing design
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EMS 0016 – Environmental Management Standard	Industrial and Construction Noise
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EMS 0007 – Environmental Management Standard	Waste management
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MCI 0006 – Mains Construction Instruction	Underground construction standards manual
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PDI5000 – Protection of Embedded Generation

SDI 120 – Testing and Commissioning for Distribution Systems Amendments

HSE Bulletin 22-16 - Community Batteries (Underground)

HSE Bulletin 23-09 - Class 9 Dangerous Goods Transportation and Storage (Batteries)

TB 0342 - Fault and Emergency Response to a Network Battery Fire/Vehicle Impact

TB 0349 - Restrictions on Mains Extension or New Services from BESS Nodes

TB 0332 – LV Battery and LV STATCOM features added to GIS and GISCAD

Design Drawings

Refer to site specific detailed designs.

4. Definitions and Abbreviations

Abbreviation	Meaning
ADMS	Advanced Distribution Management System
BESS	Battery Energy Storage System
DERMS	Distributed Energy Resource Management System
EE	Endeavour Energy

Abbreviation	Meaning
FAT	Factory Acceptance Testing
FCAS	Frequency Control Ancillary Services
DNP3	Distributed network protocol 3 – communications protocol
ITP	Inspection and Test Plan
GIS	Graphical information system
LV	Low Voltage – a voltage exceeding 50V AC but less than 1000V AC
LVCB	Low voltage circuit breaker
THD	Total harmonic distortion
ITR	Inspection and Test Report
O&M	Operating & Maintenance
QA	Quality Assurance
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SWMS	Safe Work Method Statement
VPP	Virtual Power Plant
WAE	Work As Executed

5. Practices and Procedures

5. General

5.1.1 Background

A LV Ground Battery is a grid connected battery energy storage system with an LV switchboard, which is mounted onto plinth.

LV Ground Batteries smooth out local LV network demand and generation. They can charge off excess solar generation and export this energy back into the network in periods of high demand (such as the evening period). This improves network utilisation, reliability, and quality of supply for customers.

In addition, Ground Batteries may also be directed to charge at times of low spot market price and dispatched at high spot market price, which can occur at any time. A retail partner is required for market participation. Typical markets may include market arbitrage, FCAS, virtual power plants, and power purchase agreements.

Ground Batteries on Endeavour Energy's network will serve two main purposes:

- **Network Support:** Where a LV Ground Battery is deployed solely to support the network by reducing peak demand (forecast overloading), improving solar hosting capacity, or solving quality of supply issues.
- **“Community Batteries”:** This is a metered version of a LV Ground Battery that is used for purposes of both, network support, and market services, allowing both benefits to be achieved.

NOTE: LV Ground Batteries incorporating Pixii PowerShaper batteries will predominantly function as a community battery.



Figure 1: Typical Pixii PowerShaper battery unit with Polarium battery modules and inverters.

5.1.2 Product Approval and Stock Codes

The following table provides product material numbers relating to the Pixii PowerShaper

Table 1: Pixii Product part number

Description	Part Number
Pixii Box Inverter Module	(Refer to Project Manager)
Pixii Gateway	(Refer to Project Manager)

5.1.3 Technical Specifications

The technical specifications for the Pixii (SLB48-250) and (SLB48-210) are as follows:

Table 2: Polarium Battery Technical Specifications

Specification	(SLB48-250-146-2)	SLB48-210-146-2
Enclosure Size	19" 4U	
Lithium Chemistry	Nickel based	
Rated Voltage	48 V	
Rated Capacity (0.2 C, 25 °C to LVBD)	250 Ah	210 Ah
Rated Energy (0.2 C, 25 °C to LVBD)	12954 Wh	10922 Wh
Calendar Life @ 80 % SOC	20 years	

Specification	(SLB48-250-146-2)	SLB48-210-146-2
Peak Discharge Power	6 kW for 60 seconds	
Discharge Cutoff Current	100 A	
End-of-Discharge Voltage (LVBD)*	35 V	
Charge Current Limitation (CLD)**	100 A	
Charge Voltage for 100 % SOC	58.8 V	
Charge Voltage for 80 % SOC	56 V	
Operating Temperature Charging	0 to +55 °C (32 to 131 °F)	
Operating Temperature Discharging	-20 to +60 °C (-4 to 140 °F)	
Operating Relative Humidity	According to ETSI 300 019-1-3 class 3.2 (0-95 %)	
Storage Temperature	-20 to +60 °C (-4 to 140 °F)	
Weight	Approx 66 kg (145.5 lbs.)	Approx 57 kg (125.7 lbs.)
Dimensions	W 440 D 557 H 173 mm (W 17.3" D 21.9" H 6.9")	
Circuit Breaker	100 A, BMS Controlled, single pole	
IP Class	IP20	
Communication Protocols	RS485, RJ45 (2) ports, Modbus	
Safety Standards	IEC62619, IEC62368, UN38.3	
Management & Monitoring	Software for PC (Studio) included for full local monitoring and management. Remote connection via Modbus	
*Cut off when one cell reaches 2.5 V, 14 cells in series.		
**If the charge current is 100 A or higher, the battery will automatically reduce the charge current to 6-12 A temporarily.		

Table 3: Pixii PowerShaper Technical Specifications

Performance	
Max Power (bi-directional)	Up to 50kW
Nominal AC voltage	230/400VAC
Frequency	50 or 60Hz
Max AC current (50kW)	80A
Nominal DC voltage	48Vdc
Max DC current (50kW)	1125A
Communications protocols	M-bus, Modbus RTU, TCP/ IP Ethernet, 4G Wi-Fi

Performance	
Minimum operating temperature	-20 °C
Maximum operating temperature	45 °C
Dimensions (w x d x h)	706 x 895 x 2120 mm
Weight (fully equipped)	600-800 kg
Cabinet protection class	IP 55
Colour	RAL7035
Environmental management	Fan Cooled (Aircon Optional)

Applicable standards	
Safety	IEC/EN 62109-1, IEC/EN 62109-2, IEC/EN 62040-1, IEC/EN 62477, (Batteries) IEC 62619, IEC 62368, UN38.3
Grid	AS/NZS 4777-2, VDE-AR-N 4105, 50549-1, TF 3.3.3 B1, EREC G99 (others pending)
EMC	IEC/EN 61000-6-1, IEC/EN 61000-6-2, IEC/EN 61000-6-3, IEC/EN 61000-6-4
Environment	ETSI EN 300 019:2-1 (Class 1.2), ETSI EN 300 019:2-2 (Class 2.3), ETSI EN 300 019:2-3 (Class 3.2)

Table 4: Electrical Technical Specifications

AC Mains Type	TN	IT
Max. Active Power (charge and discharge)	50kW1/40kW	40kW
Max. Apparent Power (charge and discharge)	50kVA1/40kVA	40kVA
AC voltage	400/230V, 3Ph+N+PE	230V, 3Ph+PE
Max. AC current	83Arms, 3Ph+N+PE	115Arms, 3Ph+PE
Nominal AC current	72Arms, 3Ph+N+PE	100Arms, 3Ph+PE
Frequency range	45Hz to 66Hz	
Cos φ range	0.5 inductively to 0.5 capacitively	
Protective class	Class I	
Overvoltage category	OVC III	
Supply system	TN	
Max. short circuit current	10kA	

AC Mains Type	TN	IT
Type of short-circuit protective device	MCB	
Max. Energy	48kWh/103.2kWh/120kWh	
Max. DC voltage	44V to 58V	
Max. DC current	1000A	800A

Table 5: Mechanical Specifications

Specification	Value
Height	2106mm
Width	706mm
Depth	932mm
Weight (without modules and batteries)	220kg
Weight (fully equipped, 3U batteries)	700kg
Weight (fully equipped, 4U 250Ah batteries)	830kg
Weight (fully equipped, 4U 300Ah batteries)	860kg

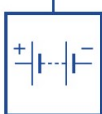
Table 6: Environmental Technical Specifications

Type of cabinet	With Fan-Filter	With Air condition
Operating temperatures	-20°C to +45°C	-20°C to +50°C
Humidity	5% to 95% RH (non-condensing)	
Storage and transportation temperatures	-30°C to +60°C	
Storage and transportation humidity	5% to 95% RH (non-condensing)	
Storage (less than 12 months)	State of Charge (SoC): 25%	
Acoustic noise (maximum)	<50dBA at 1m distance	
Maximum altitude	2000m	
Ingress protection rating	IP55	
Impact rating	IK09	
Pollution degree	3	
Wet locations	Yes	
Current (inrush)	25Apeak	

Type of cabinet	With Fan-Filter		With Air condition
Maximum output fault current	200Apeak/1ms		
Inverter topology	Isolated		
Env. cat. (IEC 62040-1:2017)	Indoor, conditioned	Outdoor	
Env. cat. (IEC 62040-1:2013)	Outdoor		
Env. cat. (IEC 62368-1)	Outdoor		
Env. cat. (IEC 60950-1)	Outdoor		
Env. cat. (IEC 62477-1)	Indoor, conditioned	Outdoor	
Env. cat. (AS 4777.2:2020)	Indoor, conditioned	Outdoor*	
* The Outdoor system rated up to only 50°C must be protected from solar radiation			

5.1.4 SAP structure and GIS Designs

Standard symbology has been created for LV Ground Batteries within GIS an ADMS. These include:

GIS – UG Battery	
Circuit Diagram	
UG Component	

For further information on the data capture process, refer to the SAP or GIS data requirements, refer to TB 0332 – *LV Battery and LV STATCOM features added to GIS and GISCAD*.

5.2 Pre-Installation

This section outlines the steps for pre-installation, installation, testing and checking, and energisation.

5.2.1 Location

The location of the community battery installation is determined on basis of network needs, factors such as transformer loading (percentage of utilisation), percentage PV customer and forecast future curtailment, Bushfire vulnerability, over/under voltage issues, network topography and stakeholder consultation. These considerations are factored in by Future Grid, Corporate Communications and Design teams to select the appropriate location for battery.

The project scope should define the battery location; therefore, Future Grid (Investment Proponent) shall be responsible to determine the final location. The Project Manager is accountable to ensure all activities are undertaken to secure the site.

5.2.2 Asset Numbering

An asset number shall be installed on the battery exterior, which represents the equipment name developed within SAP. This unique equipment name can be found on the detailed design. The following naming convention shall be followed:

- **BTGS 000X**

Where X represents unique Ground Batteries as numerical integers from 1 to 9999.

Numbering shall be installed the same as an underground network switch or distribution substation. i.e. black numbering, white background and sealed with edge sealer.

Refer to Technical Bulletin *TB 0332 – LV Battery and LV STATCOM features added to GIS and GISCAD*.

5.2.3 Easement Considerations

As a general rule, LV Ground Batteries will be installed within a road corridor or Council green space. Although there may be some exceptions where an easement is required. In this instance, the Designer shall define an easement and shall work with the property team to implement this. Easement terms shall also outline adequate access for heavy vehicles and plant. Refer to the Battery Design Guide for further information. Refer to Section 5.2.9 for recommended clearances.

5.2.4 Fire Risk and Mitigation Measures

LV Ground Batteries have been designed and manufactured to self-contain a fire if thermal runaway is encountered. As a precautionary measure, NSW Fire & Rescue have recommended a 3.0 meter exclusion zone to other assets. This exclusion zone can be reduced if a fire rated barrier is introduced. Detailed designs consider this exclusion zone.

5.2.5 Meter Box Requirements

A separate meter box shall be designed, constructed and installed adjacent to the Pixii Power Shaper battery unit as per the detailed design. Refer to Annexure H – *Standard Electrical Connection Details*.

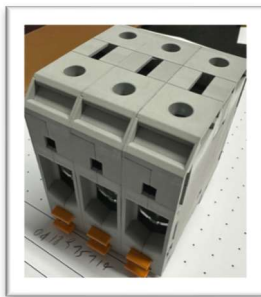


Figure 2: Temporary terminal block in lieu of revenue meter.

Initially the installation will be installed without a revenue meter, therefore a DIN rail mounted terminal block (or similar) shall be installed in the position of the revenue meter.

5.2.6 Transformer Monitoring

A permanent power quality DSub monitor is to be installed at the first upstream distribution substation.

The Dsub monitor will be installed by Field Operations as part of the applicable project and onboarded onto the Edge Zero platform by Future Grid. The meter shall be funded by the project.

5.2.7 Transport and Storage

The supplier will transport the Pixii Power Shaper battery cabinets (only) to respective Field Service Centres (FSC's). As a staged delivery, the battery cells will be transported to site by the Supplier, following the cabinets being installed.

Notes:

1. *The Pixii battery cabinets themselves do not contain Lithium-ion (dangerous goods), therefore do not need to be installed within a designated storage area.*
2. In general, Lithium-ion batteries of any size currently do not require EPA licensing; however, some special conditions may exist related to transportation of Lithium-ion battery cells (i.e. Polarium cells).

For detailed requirements on the safe transportation of Pixii batteries, refer to the Storage and Transportation of Low Voltage Network and Community Batteries Manual. For further support on dangerous goods, email environment@endeavourenergy.com.au.

ITEM	WEIGHT
Switchboard – plinth & culvert	900kg
Battery – plinth & culvert	1300kg

5.2.8 Load Restraint (Tie Down) Requirements

The supplier is responsible to deliver Pixii Power Shaper battery cells directly to site. Endeavour Energy (or nominated contractor) may be required to transport other hardware or equipment to site. As part of the Chain of Responsibilities, Endeavour Energy staff should ensure that suppliers and external contractors use appropriate load restraint methods. For more information, refer to Storage and Transportation of Low Voltage Network and Community Batteries Manual.

5.2.9 Site Preparation and Clearances

The site should be prepared in accordance with the site specific electrical design.

Notes:

- *Equipment mounting based shall be used and is adequately rated to carry the full weight the Pixii system (approx. 950kg when completely assembled).*
- *Clearances and associated easements should be considered for adequate cabinet access, including sufficient distances from adjacent assets.*

Table 7: Minimum Battery Clearances

Type of cabinet	Minimum distance		Suggested Distance	
	Fan Filter Cabinet	Cabinet with AC	Fan Filter Cabinet	Cabinet with AC
Front	80cm		100cm	
Rear	5cm		25cm	

Type of cabinet	Minimum distance		Suggested Distance	
Top	30cm		90cm	
Sides	25cm		60cm	
Between cabinets (multi-cabinet installation)	5cm	20cm	25cm	35cm

5.2.10 Prepare Installation Tools

The following tools should be used to install the battery system and connecting infrastructure, as recommended by the Supplier:

- Insulated tools suitable for electrical installations.
- Recommended tool and Torque list below:

Table 8: Recommended Tools

Tools	
W	Wrench
PZ2	Pozidriv screwdriver
Flat	Flat screwdriver
T-W	Torque wrench
T-PZ2	Torque Pozidriv screwdriver

Table 9: Recommended Torque

	Type & Size	Torque
T1	Terminal block (WDU2.5, WPE2.5, WSI4)	0,4Nm
T2	AC Mains input terminals (6-25mm ²)	12,0Nm
	AC Mains input terminals (35-95mm ²)	22,0Nm
T3	Polarium batteries (DC cables)	15Nm
T4	M5 self-tapping screw	5,7Nm
T5	M6 self-tapping screw	9,8Nm
T6	M8 hex screws	24,0Nm
T7	M10 hex screw	47,0Nm

Note: The Project Manager can assist to acquire specific tools required for the installation.

5.2.11 Prepare AC Mains Supply

Supply from the LV network and associated circuit breaker ratings shall be specified within the electrical design, and shall consider the following:

- Correct type of AC Mains supply (TN-S/IT/TT)
- Correct rating of AC input cables and external fuses
- AC Mains supply meter

Recommended circuit breaker ratings and cable requirements are shown below.

Table 10: Supply Mains

AC Mains Type	Number of Power Shelves	Maximum Current	Upstream Breaker	Input Cable
230/400Vac 3-Phase, TN-S network 5-wire system	5	83A	100A C-Curve	35mm ² – 50mm ² (CU or Al)
230/400Vac 3-Phase, TT network 4-wire system				
230Vac 3-Phase, IT/Tt network 4-wire system	4	115A	125A C-Curve	

5.3 Installation Requirements

All LV Ground Batteries and associated connecting infrastructure should be installed as per detailed designs. If the installation is unclear, the installation team should escalate any concerns to the Designer to confirm the installation requirements.

For detailed steps related to site preparation and mechanical installation refer to *Annexure A – PowerShaper Installation Method*.

For detailed steps related to the electrical installation requirements, refer to *Annexure B: PowerShaper Electrical Installation*.

For site specific detailed design requirements, refer to the electrical design.

5.3.1 Locking Requirements

As part of our Security of Critical Infrastructure (SOCI) requirements, adequate locks shall be installed to the battery unit(s) and meter box (community batteries only). The project Manager shall coordinate with locking to install D3 locks.

5.3.2 Functional Checks and Pre-Commissioning Testing

Prior to energisation, the installation shall be visually inspected, functionally checked and tested (as required) by the Responsible Officer. Refer to SDI 120 - *Testing and Commissioning for Distribution Systems Amendments* for all checking and testing requirements.

All internal connections shall be checked as per the battery installation guide and battery is safe to be turned ON and energised. The modem should be turned on.

IMPORTANT: Additionally, the manufacturers pre-commissioning checks should be followed as listed within *Annexure C – Functional Checks* and *Annexure E - Commissioning Procedure*.

The Future Grid Engineer should be available to check the connection communication is healthy. In addition, the Future Grid Engineer should be able to confirm anti-islanding operates as intended.

5.3.3 Data Capture and Validation

Prior to commissioning, the Project Manager shall enter asset serial numbers, and the Future Grid Engineer shall enter all other applicable data within the following asset register: [MASTER BATTERY & STATCOM REGISTER](#).

5.3.4 Commissioning

Once the installation is complete, the following commissioning steps must be carried out:

1. Energisation and equipment powering-up

2. Functional Checks
3. Load / capacity testing.

5.3.5 Checking for Defects

When the Pixii PowerShaper unit arrives on site, a check for defects should be undertaken. Any defects should be documented and escalated to the project Manager to manage warranty claims. An acceptance and defect form should be completed. Refer to Annexure D - Acceptance and Defects List.

5.4 Operation

5.4.1 Electrical Isolation (Normal Operation)

The Pixii PowerShaper battery can be electrically isolated from the network via a set of links within the dedicated LV switch pillar, located adjacent to the battery system. Once isolated at the LV links or LV circuit breaker, or for any upstream network outage, the LV ground-mounted battery will automatically disconnect from the network via an internal contactor in accordance with AS4777.1.

IMPORTANT: Isolation procedures for ground-mounted community batteries should strictly follow HSE Bulletin 22-16 – Isolation requirements for community batteries (underground).

Note: An Authorised person may deem it necessary to isolate at the next upstream isolation point if deemed necessary. Refer to Section 5.6 Fault & Emergency Response.

5.4.2 Identifying Battery Isolation Points

To ensure staff can identify the upstream battery isolation points, the following warning sign shall be applied to both the distribution substation and LV pillar.



Figure 3: Warning label to be applied to switch pillar and supplying distribution substation.

Note: This warning sign should also be noted on the detailed electrical design.

Isolation points internal to the battery meter box are shown below:

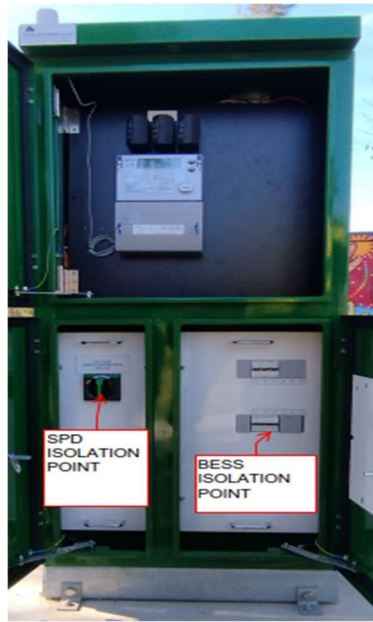


Figure 4: Isolation points within the meter box.

5.4.3 Tripping (Anti-Islanding)

The Pixii units have both passive and active anti-islanding protection, hence will automatically disconnect from the grid via an internal disconnection switch during an outage. Installation with an LVCB panel allows for the isolation via circuit breakers and fuses to provide additional safety.

IMPORTANT NOTE: Interface protection should not be installed for an Inverter energy System (IES) or multiple IES with aggregated rated power less than 200KVA at any single electrical installation as per AS4777.1:2024 section 3.4.5.1.

5.4.4 Software and Monitoring

Measurement and performance data can be viewed through the Pixii platform. Below are few lists of telemetry signals that are available to query over the API.

- Battery Cell Voltage
- State of Charge
- Inverter Active Power
- Inverter reactive Power
- Battery low voltage
- Door open
- Battery module missing
- Smoke dictator alarm
- Fan speed
- Earth fault and fuse alarm

5.5 Maintenance

Endeavour Energy staff will not modify or repair the internal power electronics associated with the Pixii PowerShaper. In the case of immediate failure, the unit should be returned to Pixii. In this instance, the Operations Manager shall refer the failure to cfg_device_notifications@endeavourenergy.com.au, where the Future Grid Engineer will further investigate and diagnose in coordination with Pixii.

For the interim, Endeavour Energy staff will not carry out maintenance of the Pixii 'PowerShaper' units until an asset management strategy is developed, outlining Endeavour Energy's maintenance approach. The Future Grid team shall monitor the battery alarms and failure events via the battery software interface. Pixii will be responsible to carry out all maintenance until specified otherwise.

For background information, to ensure that the system lifetime will be reached, regular inspections of the system are required. To be within warranty terms of the product the owner must follow the complete maintenance procedure. This procedure can be adapted based on local conditions and regulations. Pixii recommends a complete system maintenance at least once a year, except for filters and air condition unit that may need more frequent inspection based on local environmental conditions.

For further information on Pixii maintenance requirements and spare parts, refer to *Annexure F – Maintenance Requirements & Spare Parts List*.

5.6 Fault & Emergency Response

Two response scenarios are considered when responding to battery failure or impact. These include:

1. **Major incident:** Significant damage or failure is observed within the battery system or immediate connecting infrastructure, such as a motor vehicle impact or fire.
2. **Minor incident:** Minor damage or failure is observed within the battery system or immediate connecting infrastructure, such as component malfunction, hail damage, or minor damage.

Endeavour Energy first responders shall classify the incident related to the damage observed to the battery systems and connecting infrastructure. If in doubt, a major incident shall be classified.

For **major incidents**, the following actions should be taken:

1. Isolate the LV network supply at the closest point upstream without compromising health and safety. Open LV links at adjacent switch pillar or pole. If unsafe to do so, isolate from the next accessible upstream network isolation point. LV protective bonds are to be applied as per Electrical Safety Rules.
Note: If necessary, the LV battery can be completely disconnected from the network as per the Endeavour Energy Electrical Safety Rules. i.e. disconnected apparatus.
2. Contact local emergency services.
3. Secure the area and make safe until Emergency Services arrive.
4. Support Emergency Services required to address electrical hazards, limiting damage where possible to nearby assets.
5. Immediately fence off the surrounding battery area with a 3.0 meter radius from the battery as recommended by NSW Fire & Rescue.
6. Notify the relevant Field Operations Manager, who will then liaise with a Future Grid representative on the next business day via either an email to cfg_device_notifications@endeavourenergy.com.au, or a phone call to the Future Grid Engineer.

The Future Grid representative will advise the Retail provider of the incident.

An Endeavour Energy team will attend the site at the earliest opportunity. The team will consist of:

- I. Future Grid Engineer
- II. Field Operations Manager
- III. HSE Representative
- IV. Safety Representative
- V. Supplier Representative

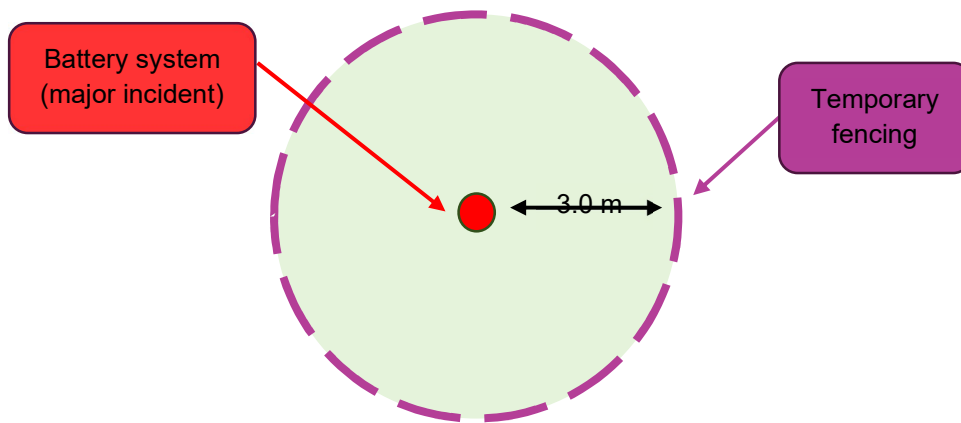


Figure 5: Temporary fencing requirements for a major battery incident.

IMPORTANT: For further information on identifying and responding to a network battery fire or vehicle collision, refer to TB 0342 - Fault and Emergency Response to a Network Battery Fire/Vehicle Impact.

For **minor incidents**, the following actions should be taken:

1. Make safe if required. Isolate if required – refer to step 1 above for major incidents.
2. Notify the relevant Operations Manager, who will then liaise with a Future Grid representative on the next business day via either an email to cfg_device_notifications@endeavourenergy.com.au, or a phone call to the Future Grid Engineer.

NOTE: Refer to the Process Map on Reactive BESS Troubleshoot_Repair Annexure H for more information.

5.6.1 BESS Subject to Intermix

Isolate the battery from the nearest safest LV isolation point and reach out to Future Grid using cfg_device_notifications@endeavourenergy.com.au. Future Grid will subsequently get in touch with the supplier, who will then assess the BESS unit onsite. Once the assessment is completed, a clearance will be issued to either energize or decommission the unit. Decommissioning can occur following the steps outlined in Section 5.6 Fault & Emergency Response.

Supplier	Contact Details
Pixii	Name : Gemma Carmody Phone: 02 8926 0049 and email: esalesAU@pixii.com

5.6.2 Recording Incidents in SAP

For all faults, defects or repairs, an incident shall be raised in SAP for the repair to be recorded, costed accordingly. The incident shall be assigned to the battery asset number.

5.7 Inventory

Endeavour Energy has an inventory agreement in place with Pixii for one (1) 40kW /100kWh Pixii PowerShaper 2 battery system.

Pixii will hold the following stock for Endeavour Energy's to draw down on for an emergency situation. e.g. the battery is damaged beyond repair via vehicle impact. The stock will be stored within the Pixii warehouse, located in Brisbane.

Following a major incident, Future Grid will be contacted to assess the need to replace the battery system. Operational teams can escalate a battery replacement assessment via emailing cfg_device_notifications@endeavourenergy.com.au or contacting the Future Grid Change and Delivery Manager. Once verified, the Future Grid team will then work the Inventory team to process the stock draw down.

The following inventory items shall be available:

Table 1: Pixii PowerShaper 2 inventory items available for emergency replacement.

Part Number	Description	Quantity
12591	PowerShaper 2 Air Conditioner	1
12000	PixiiBox 48/3.3kW Inverter	9
15820	Polarium SLB48-250-147-2, 12.6kWh NMC Batteries	8
TBC	PowerShaper 2 Acoustic Baffle	1

The following conditions have been agreed to between Endeavour Energy and Pixii:

1. Pixii will store all items at: Unit 3/40 Borthwick Avenue Murarrie, 4172, Brisbane.
2. Pixii agrees to hold:
 - a. Eight (8) Polarium Battery modules suitable for the PowerShaper 2 battery cabinet in stock.
 - b. Twelve (12) Pixii Box inverter modules in stock for the sole purpose of fitment into the Pixii PowerShaper 2 emergency stock cabinet.
3. Pixii will undertake battery module stock rotation on a first-in, first-out basis and/or periodically charge the battery modules.
4. Endeavour Energy undertake to issue a purchase order for one (1) PowerShaper 2 40kW / 100kWh system.
5. Pixii will invoice Endeavour Energy (in full) 90 days after receiving said purchase order.
6. Pixii will deliver the emergency PowerShaper 2 unit (and associated parts) within 10 working days of being instructed to do so.
7. Pixii will undertake to communicate product advancements and changes in a timely manner to assist Endeavour Energy in managing the emergency stock holding effectively.
8. Pixii will quote delivery/Installation costs based on Endeavour Energy site/location requirements.

5.8 Disposal

LV Ground 'PowerShaper' units that have been damaged beyond repair, or have reached the end of their life, shall be isolated from the network per *Section 5.6 Fault & Emergency Response* and disposed.

In negotiations with the supplier, Pixii will dispose of the entire battery system. The Operations Manager should coordinate with the internal Environmental Specialist to commence disposal activities. An email shall be sent to environment@endeavourenergy.com.au for the Sustainability & Environmental team to commence third party disposal activities.

Disposal procedures shall be followed by the third party contractor in accordance with EMS0007 – Waste management. Disposal of equipment must be registered onto the equipment register (refer to GNV 1026 – Equipment Register) and disposed with an approved method (refer to GSU 0012 – Selection and Approval of a Disposal Method).

6. Responsibilities

Manager Future Energy Strategy has the responsibility to update the document regularly based on changes to legislation, industry standards, best practice, or internal feedback.

All Endeavour Energy staff and associated third party contractors have the responsibility to maintain compliance with this manual. ^[06]

Annexure A: PowerShaper Installation Method

Preparing Site for installation

To secure the correct system operation, the BESS cabinet must be properly fixed to solid horizontal levelled surface. The Bess cabinets dimensions and position holes are detailed in figure 2. It is recommended to prepare all cables in area directly under cables entries due to the small space in plinth and for easier installation. Figure 3 shows the cable entries dimensions and positions.

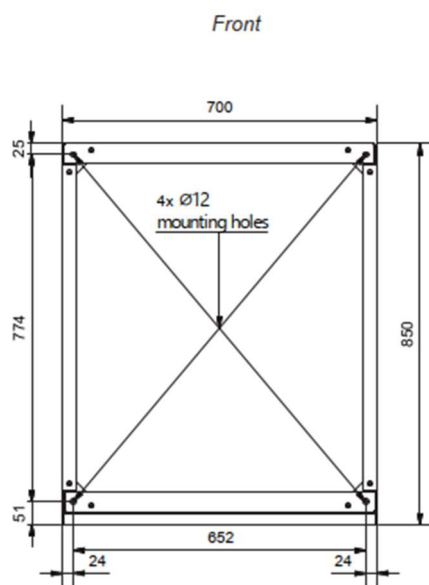


Figure 7: Drilling template – bottom view

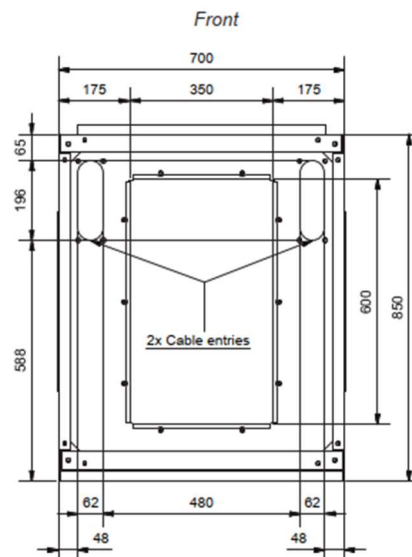


Figure 6: Cable entries – top view

Bottom Cover Plate

Remove bottom cover plate by releasing 10xM6 torx screws to provide better access for installation of cables.

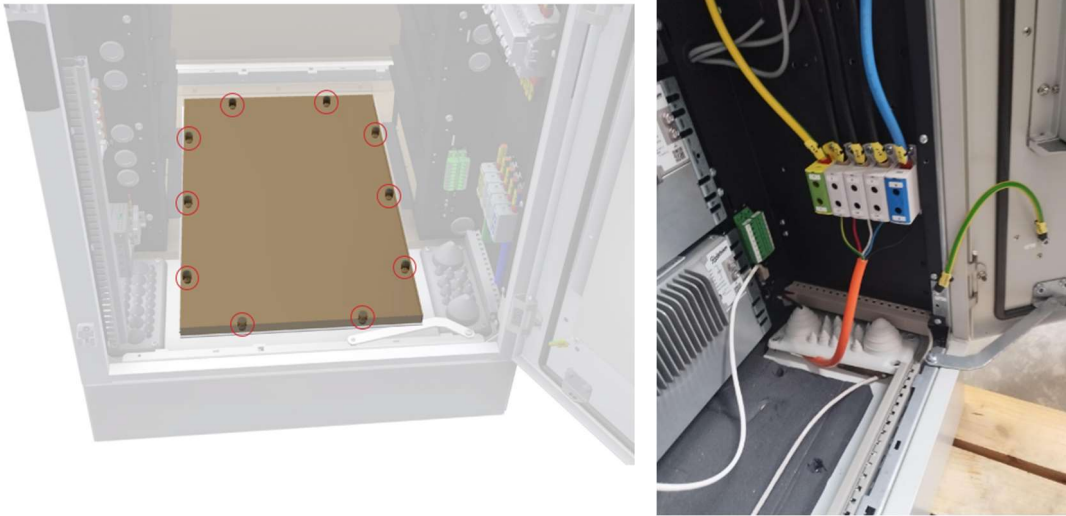


Figure 8: Removing the bottom cover plate.

Fixing the cabinet

Antennas will be pre-installed at factory level on top cap as seen in figure 6.



Figure 9: Unmount cabinet roof.

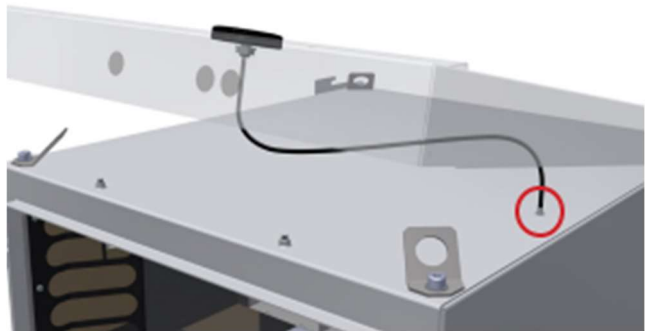


Figure 10: Disconnect antenna cable.

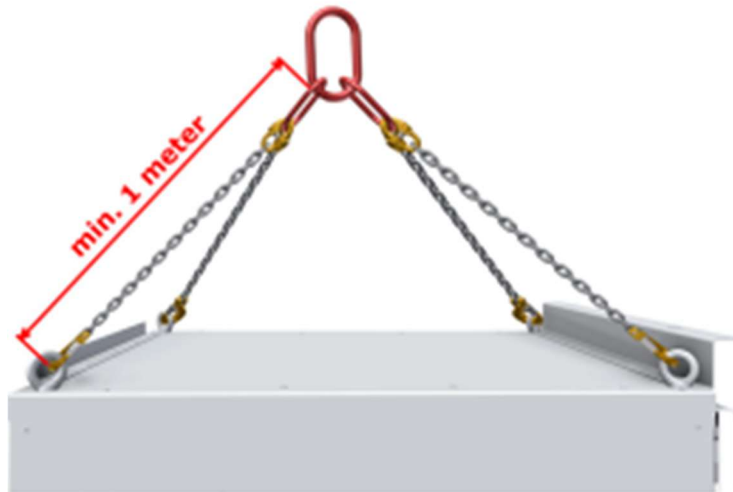


Figure 11: Cabinet lifting.

- Unscrew 2XM6 nuts on front bottom roof side as per figure 5 above
- Lift up roof, disconnect antenna cable (if present) and remove cabinet roof (see figure 6)
- Fix chains or straps (minimum length 1 meter) to all lifting lugs (see Figure 7), securely lift and move system to the desired position
- Use 4x M10 screw to fix cabinet to ground, correct torque depends on type of screws and material of mounting base.
- Put back cabinet roof, connect antenna cables (if present) and fix roof to cabinet with 2x M6 nuts.

Annexure B: PowerShaper Electrical Installation

Ensure that the cable termination between the Electrical switchboard and the Pixii PowerShaper is terminated as per detailed designs.

For safety reason, before you start installation, ensure all external power sources are disconnected, as to well as internal battery and load fuses/breakers. To avoid injuries caused by high leakage/touch current you must always start installation by connecting earthing wire (PE), before you connect other AC input wire (phase, neutral).

Preparation

Remove plastic cover (highlighted in yellow) by releasing 5x M5x10 torx screws.



Figure 12: Removing the plastic cover.

Earthing / Protective Bonding

It is necessary to interconnect cabinet chassis with main earthing point, to ensure equal potential throughout the installation thus preventing a hazardous potential difference occurring between such parts in the event of a fault. Connect bonding cable from main earthing point to the bonding copper busbar on the bottom of the cabinet with M8 lug.

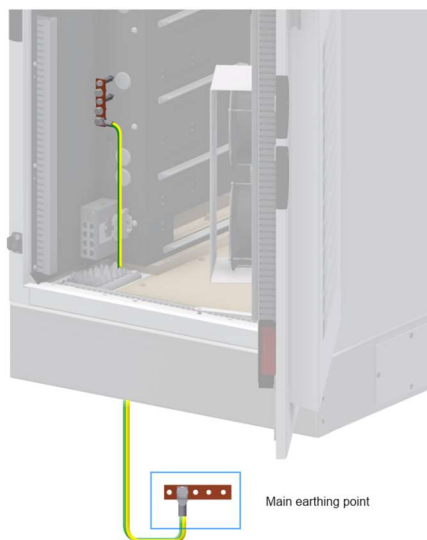


Figure 13: Earth/protective bonding.

Earthing requirements must comply with detailed designs. Key specifications are as follows:

- Install one (1) **12mm** diameter copper clad electrode at a minimum depth of **1.2m**.
- A main earth cable to be connected between the main electrode and main earth bar. See earthing design for cable dimensions.
- 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.
- A MEN link must be installed between the main earth bar and main neutral bar. See earthing design for cable dimensions.

Earthing requirements comply with AS62103. All metal on the PIXII BESS is earthed. The earthing point of the PIXII BESS is through an earthing stud installed on the gland plate at the bottom of the unit.

AC Mains Connection (TN-S /TT 230/400V AC)

Connect the incoming phase conductors, neutral and earthing conductors. Ensure that the cable termination between the Electrical switchboard and the Pixii PowerShaper is terminated as per detailed designs.

Route the power cables under the housing into the BESS electrical area from the LV switchboard as how in figure 11 and as per EE’s earthing design details.

Notes:

- *If using multi stranded flexible cables, appropriate ferrules (i.e. Bootlace) must be used at screw terminals.*
- *Endeavour Energy are to provide cable lugs and glands.*
- *The rubberised Cable Gland supplied with the Pixii unit is to be replaced with the Aluminium Gland Plate. Cable glands and plates must be sealed to prevent ambient air ingress and satisfy IP class IP55 requirement.*
- *The modem, antenna and communications cables should be installed in the Pixii unit by the Supplier*
- *Connect PE wire to terminals X1. Use torque T1.*
- *Conductor (CU, AL) as per design drawing.*
- *Connect phase wires (L1, L2, L3) and neutral wire (N) to terminals X1 (see Figure 11). Use torque T2*
- *Conductor (CU, AL) as per design drawing.*

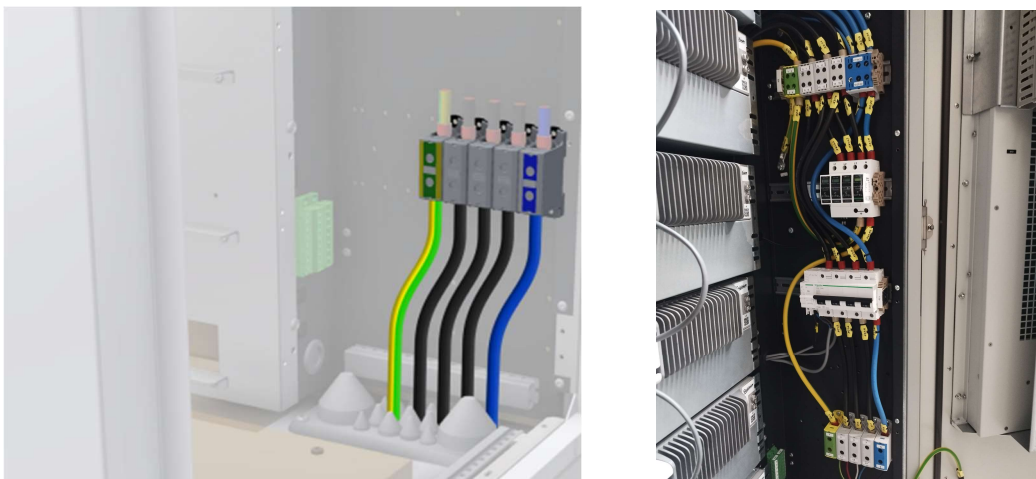


Figure 14: AC mains cable – 400Vac network.

Communication

Pixii system is fully configurable through web interface. Therefore, a network connection to controller is required. This can be done in different ways, depending on what type of network is present on site. The system has a Wi-Fi Access Point that can be activated to access the web interface for configuration and monitoring when at the site. System is also equipped with 4G router that can be used to connect system to Internet.

The PIXII PowerShaper contains Endeavour Energy supplied 4G modems which are connected to Endeavour Energy's 4G APN. This allows telemetry data to be continuously streamed back into Endeavour Energy's environment to monitor the status and effectiveness of the units.

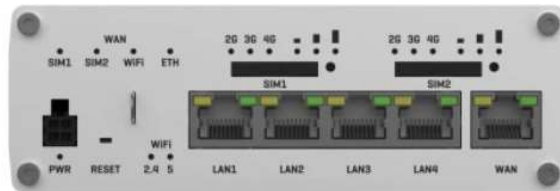


Figure 15: Similar Intercell Modem

4G router is pre-configured and equipped with activated SIM card. No additional electrical connection is needed.

Battery Installation

IMPORTANT NOTES:

1. Mount back bottom cover plate before installing the batteries. This should be provided by Pixii.
2. If there are empty battery racks, the cavities must be covered by blank panels to obtain correct air flow inside the cabinet.

The cabinets are prepared by default for 3U batteries (up to 10pcs) from factory, with 148mm spacing between battery supports. It is possible to use 4U batteries (up to 8pcs) as well, but the battery support brackets spacing must be adjusted to 187mm. Bottom battery position is the same for both options.



Figure 16: 3U battery option (up to 10pcs).

Note: The back bottom cover plate needs to be mounted before installing the batteries, as mentioned previously. Refer to figure 6.



Figure 18: 3U battery position.



Figure 17: 3U battery installation.

Using different models of battery modules together is not permitted. Be careful during installation, because of the high weight of the battery. It's strictly recommended, that batteries are installed by 2 persons. Batteries must be installed in order from bottom to top (see Figure 13). Place each battery back side at the rails and slowly slide them in correct position. Fix each battery with at least 2x M6 (depending on the accessible holes on the mounting brackets) self-tapping screws (see Figure 4.), using torque T5.

IMPORTANT NOTE: *As an interim measure, Endeavour Energy will engage Pixii to install the battery modules on site using a mechanical aid.*

Battery Connection

Each battery module contains an internal Battery Management System (BMS) and a breaker to secure safe operation. Before connecting the batteries, check once again that all batteries are the same type. If the check was successful, start connecting the batteries.

1. Connect each battery module to those adjacent to it using an intra-rack RJ45 communication cable. For connection use Modbus ports on batteries.
2. Interconnect connector -X21 with the bottom battery Modbus port using attached RJ45 communication cable.
3. Fix cables to avoid contact with fans, heaters and other equipment mounted on door if needed.
4. Connect the positive cable (red, marked -GB1:+) to the bottom battery positive terminal.
5. Connect the negative cable (black, marked -GB1:-) to the bottom battery negative terminal. 6. Repeat step 4 and 5 to connect all other batteries installed in the system (see Figure 18 below).

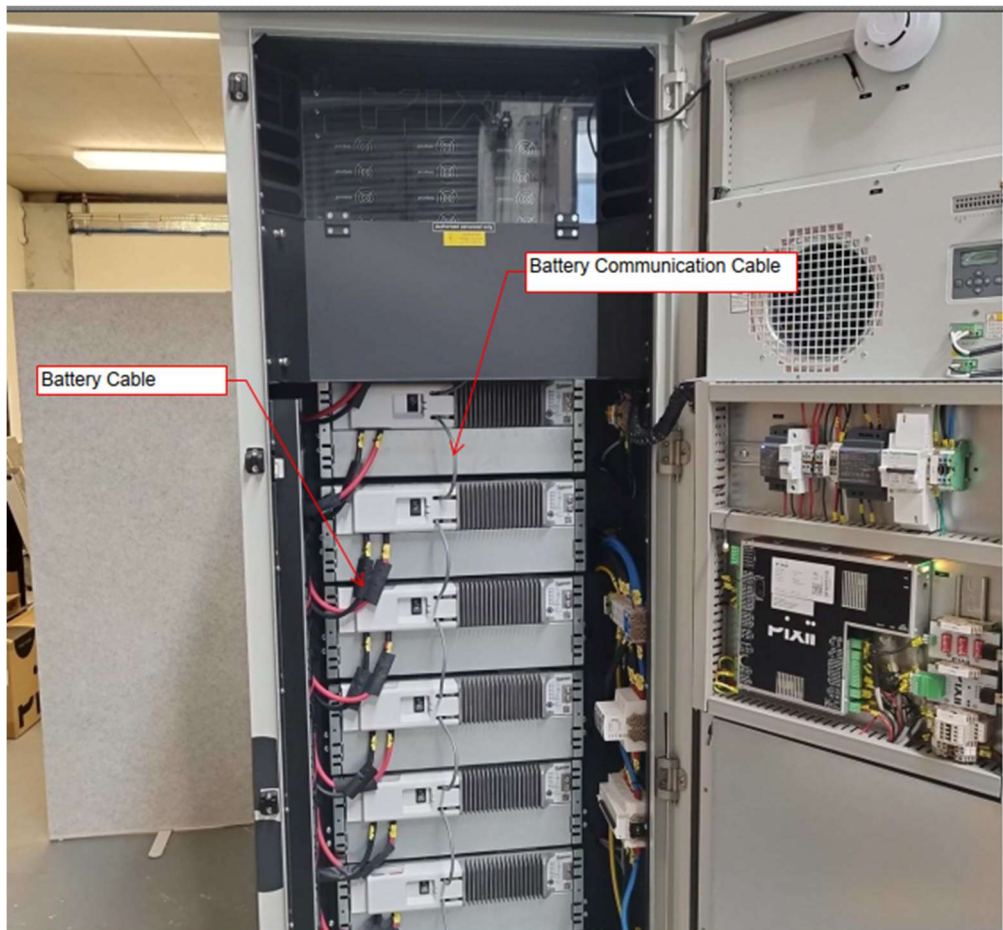


Figure 19: Battery communication and Battery cable.

Notes:

- Do not power on batteries at this stage of installation.
- Ensure, that battery cables are not in/not colliding with air gap between the batteries. It could cause
- overheating problems.
- Insert termination plug to the last unused Modbus port. See details in Figure 15
- Ensure, that battery cables are not in/not colliding with air gap between the batteries. It could cause
- overheating problems.

Annexure C: Functional Checks

The PowerShaper incorporates both passive and active anti-islanding functionality. The passive methods included are under/over voltage, under/over frequency, and rate of change of frequency detection. The active anti-islanding functionality uses the frequency shift method based on feedback from frequency variation in combination with a small reactive power perturbation.

Active Anti-Islanding Check

- Once EEs Power Quality Engineer is satisfied that all readings are available at the remote end, advise him/her that the equipment will be switched off to confirm anti islanding.
- Open the SPD (100A) grid circuit breaker within the LV switchboard.
- Check that the unit trips in < 2s and reports an active anti-island trip by checking for any power supply on the outgoing terminal on the LV Switchboard (BESS) 50A CB. (Note: no power supply should be available)
- Close the SPD (100A) grid circuit breaker within the LV switchboard.
- After few minutes communicate with EEs Power Quality Engineer to confirm communication has been established.

Note: Anti-islanding checks should occur both for the battery system and separate LV enclosure.

PowerShaper detailed Startup

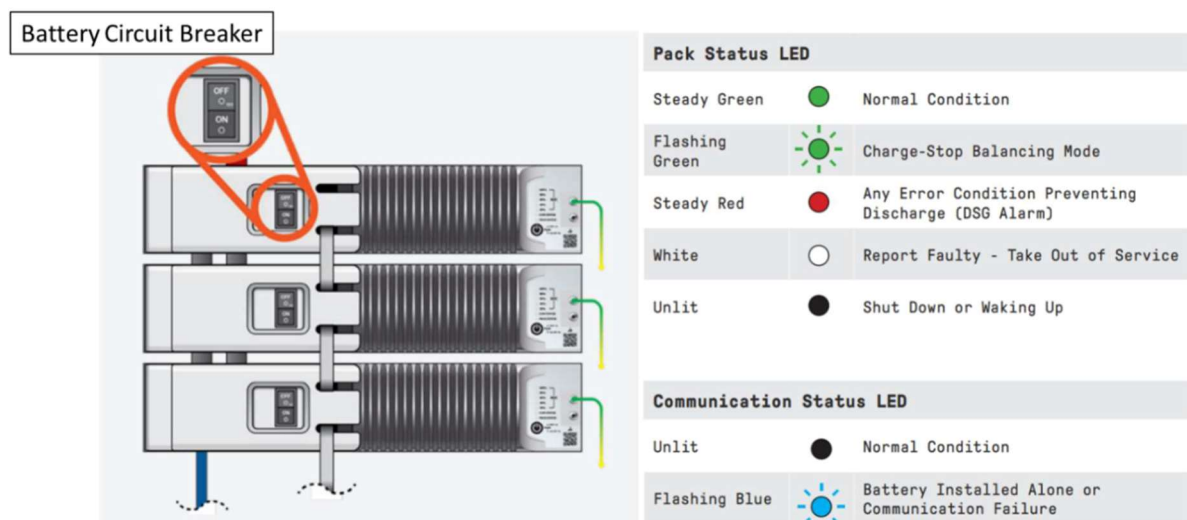


Figure 20: Battery Circuit Breaker and LED status.

This test brings the system online and available for operation (No Load). When connected to grid, the system Voltage is the same as the grid Voltage.

Tab 16: Step by Step Startup

No	Step	Acceptance Criteria / standard	Comments
1	Ensure site is safe for PowerShaper energization	Define by site specific requirement and installer risk assessment	
2	Permission to Proceed	Permission granted by Site Supervisor	
3	Slide the Pixiiboxes out approximately 5cm to disconnect them from the rear connector	Pixiiboxes will not energize at startup	

No	Step	Acceptance Criteria / standard	Comments
4	Confirm rotation at X1	Clockwise	
5	Measure and record Line to Neutral voltage for L1, L2 and L3	Record values – all voltages should be similar.	
6	Turn on the supply, CB1 (Main Switch) and Control Power Supply, CB2	Lights appear at the Gateway	
7	Confirm communication with the Gateway is possible	Via Pixii Gateway web portal	
8	Check communication system is functioning	Defined by site specific requirements and client Communication system	
9	Turn on each Battery Circuit Breaker	Refer to figure 17	
10	Turn on one battery, each battery should then power on automatically	status light Green Comms Status light	
11	Confirm all batteries are powered on and that the communication light is not flashing	All Batteries are powered on and communication light is not flashing Refer to Figure 17	
12	Slide Pixiiboxes in one at a time until they are all seated correctly with three rows of three modules starting from the bottom left	Wait for 2 Minutes and the Status indicators will turn green with No Load	
13	Via the web HMI ensure all batteries are showing no alarms and the SOC's are within 10% of each other	Record SOC of all batteries on the web portal record SOC of Batteries	
14	Verify battery temperatures are between 15-40°C	Visual check via web HMI	
15	Via the WEB HMI ensure all inverters are showing no errors or update if required	Confirm voltage as measured by pixiiboxes	
16	Check communication s with upstream services is ok.	Confirm RTU edge device is receiving data	

Annexure D: Acceptance and Defects List

List defective items within the below table.

#	Detailed Description	Date of Completion

With its signatures the customer confirms acceptance of the system delivery. Any outstanding items as detailed above shall be brought to in order by Pixii or its representative within an agreed period of time.

Place

Date

Signature

Company

Name

Title

Place

Date

Signature

Company

Name

Title

Annexure E: Commissioning Procedure

The following procedures are specified by the Supplier, therefore are additional requirements to SDI120.

System Data Capture Requirements

The following system data shall be captured manually and sent to cfg_device_notifications@endeavourenergy.com.au. Once SAP maintenance and reporting systems are established, this data will be stored within SAP.

System data	Comment
System number:	
System Serial number:	
System role (Master, Slave)	
Cabinet number/Total number of cabinets:	
Gateway Serial number and HW address:	
Master Gateway Serial number and HW address:	
Network type (TN, IT, TT):	
Number of modules installed:	
Number of batteries installed:	
AC meter type and parameters:	
Customer name, site name and country	
Commissioning responsible person:	

Pre-start checks

The following pre-start checks should be carried out.

No	Check following	Confirm
1	Mechanical and electrical installation is completed.	
2	System is compatible with grid parameters at point of installation.	
3	All external and internal breakers are switched OFF.	
4	All AC input cables are correctly connected to Mains input terminal and breaker.	
5	All battery cables are correctly connected to batteries.	
6	Ensure batteries are turn off	

Visual Inspection of internal Elements

The following visual inspections should be carried out.

No	Activities	Confirm
1	Ensure no tools are left inside	
2	Ensure cables are secure	
3	Ensure inverter shield is in place	
4	Ensure there is no visible damage to cables or components	
5	Ensure that all covers are in place	
6	Ensure that the system is clean	
7	HOLD: Ensure all live testing safety procedures are in place	

Electrical Testing

In addition to SDI120, the following should be considered when carrying out electrical testing.

No	Activities	Confirm
1	Ensure electrical testing of external cables has been carried out. Note: Do not Megger Test Power Electronics	

Energisation and Powering-up Steps

After all works has been completed and prior to commissioning, check the following:

- (i) The incoming switch and CBs on the electrical control panel are in the **OPEN** position
- (ii) Ensure all connections on the Pixii BESS are intact
- (iii) Ensure the all the CBs inside the Pixii unit is in **CLOSE** position see figure 17
- (iv) Close the door of the Pixii unit
- (v) Confirm the fuses are **pulled out** from the outgoing LV feeder in the relevant padmount sub. (note: where a low voltage dedicated feeder is not available, and a double connection was installed at the substation strip fuses, supply could be energised up to the battery electrical control panel).
- (vi) Confirm the links are closed in the LV pillar
- (vii) Where the meter has been installed, confirm the fuses are in and all connections are intact



1. Where required, insert the fuses into the LV switchgear in the padmount substation



2. **CLOSE** all CBs in in the electrical control panel



3. **CLOSE** the incoming switch in the electrcial control panel



4. Open the Battery door and confirm the bottom LED lights are blinking

5. After few minutes communicate with the nominated Future Grid Engineer to confirm communication has been established.

Start-up

The following steps should be followed when initially energising the battery.

Startup Steps	Confirm
1. Switch ON external and internal Mains input breakers.	
2. Switch ON required internal breakers (do NOT switch ON batteries at this point!!!).	
3. Check if modules and control units are running.	
4. Check if switch and 4G router are running	

Annexure F: Maintenance Requirements and Spare Parts List

For repair and replacement use only original Pixii parts and in accordance with technical specification provided by Pixii. Use of non-original parts may void the warranty provided by Pixii.

System

- Remove all objects around cabinet that can block air flow.
- Check for physical damage on the cabinet body. Repair scratches with paint. If the cabinet body has severe damage, like deformation or holes, the system should immediately be taken out of operation and replaced with a new cabinet.
- Check the door hinges and apply oil or grease if needed.
- Check that the door gasket has no visible damage.
- Check that all cabinet entry points are correctly sealed and there is no possibility of water and dust entering the cabinet.
- Check the batteries, look for possible leakage and mechanical damage.
- Check that all accessible cables are not mechanically damaged.
- Check that the mains input cable well tightened.

Fan

- Check that the fans are running without any abnormal noise.
- Disassemble outlet filter frame and visually check filter from both sides.
- Disassemble inlet filter box and visually check filter from both sides.

Air Condition Unit

To ensure the normal operation of the air conditioner, please perform regular maintenance

Check Item	Step Description	Torque
Wiring	Visually check if the wiring is loose	0,4Nm
Fan abnormalities	Turn the fan to check if it is smooth and if there is any abnormal noise	12,0Nm
Drainage pipe	Visually check if the drainage mouth is blocked	22,0Nm
Condenser	Check the cleanness of the condenser and clean it with compressed air	15Nm

Warning:

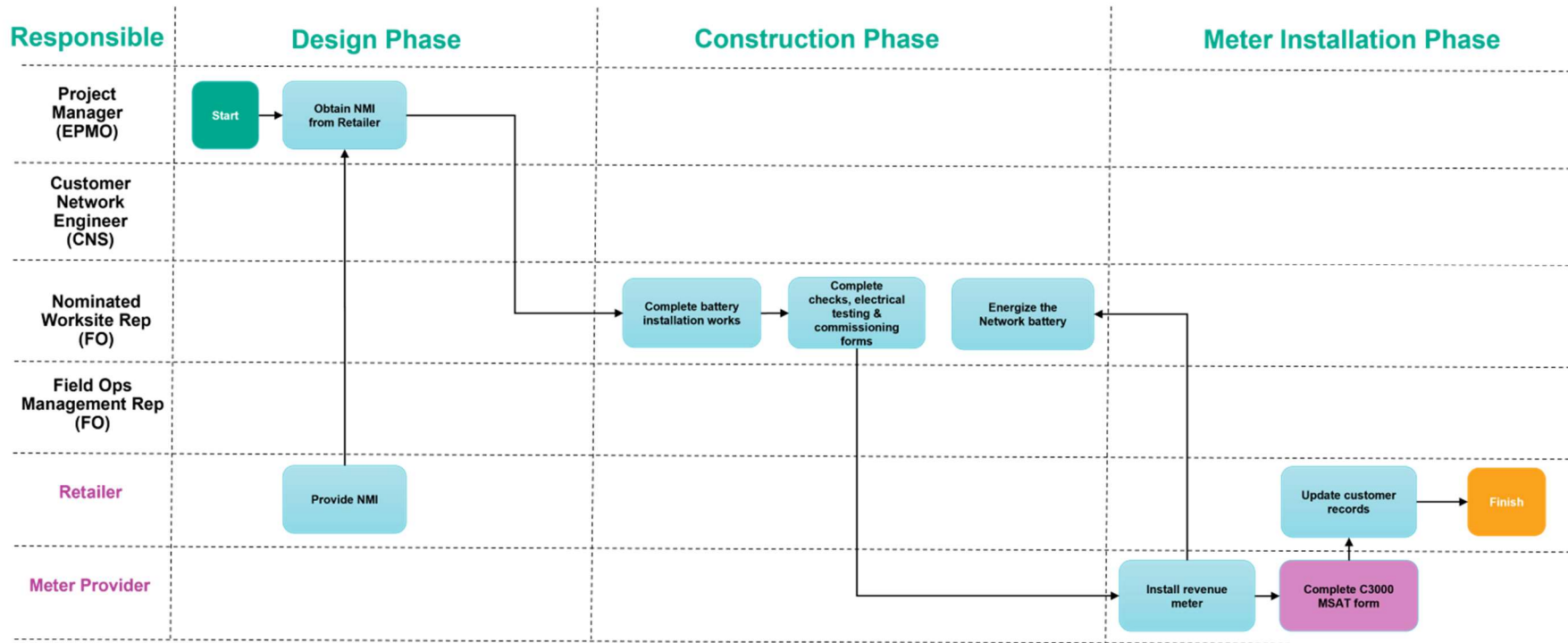
- *Disconnect the power and signal cables of the air conditioner before any maintenance and do not reconnect them until the maintenance is completed*
- *After the air conditioner is power on, check whether the air conditioner enter the normal interface, without alarm. Then perform the self-testing and check whether the whole process is normal.*

Spare Parts List

	Description	Part Number	QTY
1	Pixii Box Inverter Module	12000V1.8	1
2	Pixii Gateway	12100	1
3	Power Supply	13842	1
4	SPD Set 3 Phase Citel	11899	1
5	Schneider C120 MCB 100A 4P	14051	1
6	Fuse 10A 400Vdc DC Time Lag	13149	10
7	Door Switch	13817	1
8	Fuses 10A 5X20		10
9	MCCB Main 250A 3P 50kA	LV431830	1
10	MCB 10A 6kA 1P	A9F44310	1
11	MCB 4A 6kA 3P	A9F44104	1
12	Fuse 32A 10X38		10
13	Relay Aux 240Vac	7760056104	1
14	Accuvim Energy Meter	Accuvim IIR-D-5A-P2	1
15	Web Module with 8GB memory	AXM-WEB2	1
16	Polarium 210AH 10.1kWh Lithium Battery	15289	1
17	Polarium 250AH 12.5 kWh Lithium Battery	14043	1
	Envicool 3kW Combo Air conditioner	13993	

Annexure G: Community Battery Connection & Registration Process

Community Battery Connection and Registration Process – Ground Mounted BESS



Important Notes:

- E.E will isolate the LV prior to Retailer works and LVAA will be issued which will be held by E.E staff but Retailer staff will sign on/off;
- Retailer staff will not need to be E.E authorised but will work under the direct supervision of E.E staff;
- E.E will provide Traffic Management (if applicable);
- Retailer will work to E.E safe systems of work and will sign on the risk assessments.

Annexure H: Process Map on Reactive BESS Troubleshoot repair

