

Substation Maintenance Instruction

Substation batteries

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Substation Maintenance Instruction

ASSET STANDARDS & DESIGN

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SMI 102 SUBSTATION BATTERIES

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1.0 PURPOSE

To set the standard for the maintenance of substation batteries for transmission and zone substation.

2.0 SCOPE

This instruction is to be read in conjunction with SMI 100 for transmission and zone substation equipment and SMI 101 for distribution equipment.

It defines the broad routine maintenance requirements for substation batteries.

3.0 REFERENCES

Internal

- Company Policy 9.9.1 - Network Asset Maintenance
- Company Procedure GSY0067 – Personal Protective Equipment
- Company Policy 4.0 - Environment
- Company Procedure GPE 0060 - Environmental Incident Response And Management
- Company Form FSY 0118 - Worksite Coordination/Hazard and Risk Assessment
- Substation Maintenance Instruction SMI 100 – Minimum requirements for maintenance of transmission and zone substation equipment
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
- Substation Maintenance Instruction SMI 124 – Maintenance data entry and defect prioritisation
- Substation Maintenance Instruction SMI 113 – Distribution and field transmission data asset structure and nameplate details
- Substation Maintenance Instruction SMI 119 – Transmission and zone substation data entry, asset structure and details
- Network Management Plan December 2013 Review

External

- ENA National Electricity Network Safety Code (NENS 01-2008)
- *Electricity Supply Act*, 1995 (as amended)
- Work Health and Safety Act 2011(NSW)
- AS 2676.1:1992 – Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings, vented cells
- AS 2676.2:1992 – Installation, maintenance, testing and replacement of secondary batteries in buildings, sealed cells
- AS/NZS 4029:2:2000 – Stationary batteries, lead acid, valve regulated type
- AS 4029.1:1994 – Stationary batteries, lead acid, vented type
- AS 3731.1:1995 – Stationary batteries, nickel cadmium, vented type
- AS 4044:1992 – Battery chargers for stationary batteries

4.0 DEFINITIONS AND ABBREVIATIONS

DC	Direct Current
ELLIPSE	Endeavour Energy's asset database
LAN	Local area network

VRLA Valve regulated lead acid

Comms Batteries Battery banks with a nominal voltage of 54v installed for the purpose of providing backup supply to the communications network.

5.0 ACTIONS

5.1 General

All work is to be carried out in accordance with the manufacturer's recommendations, unless otherwise specified. Readings taken during the tests and all work carried out, including the quantity of electrolyte added, number of faulty cells found and replaced, must be reported.

Single cell and/or full bank equalise charging must be carried out on *vented* lead acid cells as required (as condition based maintenance) in accordance with the manufacturer's recommendations, to equalise cell voltages and specific gravities, where applicable.

When boost charging (vented cells only), it may be necessary to disconnect the battery from the DC bus to prevent over-voltage on the DC system.

5.2 Routine maintenance schedules

5.2.1 Substation and Comms (54v) Batteries

(excl. 12v cells, dry type, recloser and field switches)

Battery testing and charging	Nickel cadmium		Lead acid vented		Lead acid sealed/ VRLA	
	120V	54V	120V	54V	120V	54V
1.0 INSPECTION						
All defects found must be reported.	x	x	x	x	x	x
Check general appearance of batteries, charger, lighting and cleanness of the battery area.	x	x	x	x	x	x
Check for abnormal conditions or signs of deterioration.	x	x	x	x	x	x
Check ventilation equipment and openings.	x	x	x	x	x	x
Check for cracks or distortions in battery containers or covers.	x	x	x	x	x	x
Check status of positive and negative earth fault lamps if applicable.	x	x	x	x	x	x
Check charger output-current, float voltage, on/off switch, alarms for correct operation, and adjust if necessary. Typical float voltage – nickel cadmium 1.42V/cell, lead acid 2.25 V/cell.	x	x	x	x	x	x
Check electrolyte level of each cell.	x	x	x	x		
Check condition of intercell and main battery connections.	x	x	x	x	x	x
Check plates of cells with transparent containers for distortion, lateral expansion and irregular colour.	x	x	x	x	x	x
Check integrity of battery stand and enclosure.	x	x	x	x	x	x

Battery testing and charging	Nickel cadmium		Lead acid vented		Lead acid sealed/ VRLA	
	120V	54V	120V	54V	120V	54V
2.0 MINOR OVERHAUL						
Inspection as set out in 1.0 above.	x	x	x	x	x	x
Report the electrolyte density of each cell to two (2) decimal points. <i>Equalise charge if the cell electrolyte density is 10kg/m³ below the battery average, or 10kg/m³ below a previously recorded value.</i>			x	x		
Report the electrolyte temperature of the first cell (#1) and the last cell.	x	x	x	x		
Top up the electrolyte and report any cells that have a different consumption rate of electrolyte from the average cell.	x	x	x	x		
Re-adjust float voltage to the correct value to one (1) decimal point. Typical float voltage – nickel cadmium 1.42V/cell, lead acid 2.25 V/cell.	x	x	x	x	x	x
Report the surface temperature of the first cell (#1) and the last cell.					x	x
Disconnect the battery charger from the bank and report the voltage of every cell to two (2) decimal points. All cell voltages taken as a final measurement must typically be a minimum of 1.2v for nickel cadmium cells and 2.04v for lead acid cells. Any cells reading less than this will warrant further evaluation of battery condition. <i>Sealed cells</i> - switch the battery charger on and float charge to slowly return battery capacity. <i>Lead acid vented cells</i> - switch the battery charger on and boost charge (nominal 2.8V/cell) until the electrolyte density is restored and the voltage remains constant at the nominal value. <i>Nickel cadmium vented cells</i> - switch the battery charger on and boost charge (nominal 1.65 V/cell) until the voltage remains constant at the nominal value. Return the battery charger to float charge .	x	x	x	x	x	x
Measure the voltage drop across inter-cell connectors. When the voltage drop across any inter-cell connector exceeds its initial value by more than 20%, clean all contact surfaces and retest.	x	x	x	x	x	x
Clean all terminal posts and connecting hardware.	x	x	x	x	x	x
Clean all cell covers with a clean wiper moistened with water, and dry with clean cloth.	x	x	x	x	x	x
Coat terminal posts with a thin film of corrosion-inhibiting grease in accordance with the manufacturer's instructions.	x	x	x	x	x	x
Clean vent-caps and so that they are operating correctly and form an effective seal.	x	x	x	x		
Check tightness of bolted connections.	x	x	x	x	x	x
Clean battery room.	x	x	x	x	x	x

Battery testing and charging	Nickel cadmium		Lead acid vented		Lead acid sealed/VRLA	
	120V	54V	120V	54V	120V	54V
3.0 DISCHARGE TESTS						
3.1 Quick discharge test						
Quick current discharge testing is required to check the intercell integrity. High resistance connections will be indicated either by a higher than normal voltage drop across intercell connections, typically 0.5 to 1.5 millivolts, or abnormal heat generation. Quick discharge test as fast as possible by connecting to an external load with battery in service and battery charger switched off. Lead acid: - The maximum external load must be approximately equal to Ampere-hour capacity @ 10 hour rate ÷ 5 (for example: 100 A/H @ 10 hour rate ÷ 5 = 20A). Ni Cd: - The maximum external load must be approximately equal to Ampere-hour capacity @ 5 hour rate ÷ 5 (for example: 100 A/H @ 5 hour rate ÷ 5 = 20A). Report: - Voltage at DC control panel. - Voltage at battery terminals. - Voltage across each cell. - Voltage across each cell interconnection. - Discharge current. Rectify found defects. All cell voltages taken as a final measurement must typically be a minimum of 1.2v for nickel cadmium cells and 2.04v for lead acid cells. Any cells reading less than this will warrant further evaluation of battery condition. Sealed cells - switch the battery charger on and float charge to slowly return battery capacity. Lead acid vented cells - switch the battery charger on and boost charge (nominal 2.8V/cell) until the electrolyte density is restored and the voltage remains at a constant value for 2-3 hours. Nickel cadmium vented cells - switch the battery charger on and boost charge (nominal 1.65 V/cell) until the voltage remains a constant value for 2-3 hours. Return that the battery charger to float charge.	x	x	x	x	x	x

Battery testing and charging	Nickel cadmium		Lead acid vented		Lead acid sealed/VRLA	
	120V	54V	120V	54V	120V	54V
4.0 CAPACITY TEST						
Capacity testing is required to test a battery's ability to deliver a specified current for a specified time to determine the battery's Ampere-hour capacity. If the battery does not deliver its expected capacity, the test should be repeated after re-charging and a check made for high resistance battery connections. A battery with a manufacturer's Ampere hour capacity below 80%, or with a drop in rated capacity of more than 10% from previous test, will warrant further evaluation of the condition of the battery. Capacity test by connecting to an external load with cells fully charged, charger switched off and station load disconnected. Lead acid battery: - The constant discharge current must be approximately equal to the Ampere-hour capacity @ 10 hour rate ÷ 5 (for example: 100 A/h @ 10 hour rate ÷ 5 = 20A). - The discharge current must be applied until the termination voltage (nominal 1.8V/cell) is reached on a total of two (2) cells. Nickel cadmium battery: - The constant discharge current must be approximately equal to the Ampere-hour capacity @ 5 hour rate ÷ 5 (for example: 100 A/h @ 5 hour rate ÷ 5 = 20A). - The discharge current must be applied for five (5) hours or until the termination voltage (nominal 1V/cell) is reached on a total of ten cells. Temporary fuse protected bypass device must be used during the test to remove faulty battery cells that fall below the termination voltage. Monitor each cell voltage at 30-minute intervals (nominal), checking cells at increasingly frequent intervals appropriate to the rate of deterioration. Report: <i>Initial measurements prior to discharge:</i> - Electrolyte density of each cell (vented cells only). - Voltage of each cell. - Voltage at battery terminals. - First cell (#1) temperature. <i>Discharge measurements</i> - Voltage of each cell at 30-minute intervals during the discharge test. - Electrolyte density of each cell at 30-minute intervals during the discharge test (vented cells only). - Voltage at battery terminals at 30-minute intervals during the discharge test. - First cell (#1) temperature at 30-minute intervals during the discharge test. - Discharge current at 30-minute intervals during the discharge test. - Time of each measurement. Rectify found defects. <i>Sealed cells</i> - switch the battery charger on and float charge to slowly return battery capacity. <i>Lead acid vented cells</i> - switch the battery charger on and boost charge (nominal 2.8V/cell) until the electrolyte density is restored and the voltage remains at a constant value for 2-3 hours. <i>Nickel cadmium vented cells</i> - switch the battery charger on and boost charge (nominal 1.65 V/cell) until the voltage remains a constant value for 2-3 hours. Return the battery charger to float charge.	x	x	x	x	x	x

Routine Battery Replacement	Nickel cadmium		Lead acid vented		Lead acid sealed/VRLA	
	120V	54V	120V	54V	120V	54V
5.0 ROUTINE BATTERY REPLACEMENT						
Batteries must be routinely replaced as indicated in SMI 100.	x		x		x	

5.2.2 Misc. 12v, Recloser and field switches and dry type.

Routine battery replacement	Recloser and field switches	Misc. 12V cells	Dry type
5.0 ROUTINE BATTERY REPLACEMENT			
Batteries must be routinely replaced as indicated in SMI 100 or SMI 101.	x	x	x

6.0 AUTHORITIES AND RESPONSIBILITIES

6.1 General Manager Asset Management

General Manager Asset Management has the authority and responsibility for approving this instruction.

6.2 Manager Asset Standards & Design

Manager Asset Standards & Design has the delegated authority and responsibility for approving this document for minor changes and to make recommendations to the General Manager Asset Management for major changes.

6.3 Endeavour Energy employees and/or contractors

All Endeavour Energy employees and contractors are responsible for:

- Conducting themselves in a manner that meets the requirements of this instruction and SMI 100 (for transmission and zone substation equipment) or SMI 101 (for distribution substation equipment) are met when carrying out battery maintenance.
- Working in accordance with local and statutory requirements.
- Managing public safety so that it is not compromised.
- Working in accordance with Endeavour Energy's Electrical Safety Rules.

6.4 Regional Transmission Manager

The Regional Transmission Manager/Distribution Project Manager is responsible for:

- Overseeing that Endeavour Energy employees and/or contractors engaged to perform the work have appropriate qualifications.
- Identifying potential problems with equipment when test reports are received.

6.5 Battery Technologists or Contractors

Battery Technologists or contractors are responsible for:

- Maintaining and testing batteries, battery chargers and associated equipment in accordance with this instruction.
- Updating the Endeavour Energy ELLIPSE database, together with reporting all test results in G:\EE Maintenance.
- Rectifying and/or reporting potential problems when carrying out the work.

6.6 Network Maintenance Manager

Network Maintenance Manager must be responsible for analysing the test results to identify potential problems, and taking appropriate action.

7.0 DOCUMENT CONTROL

Documentation Content Coordinator : Network Maintenance Manager

Documentation Distribution Coordinator : Branch Process Coordinator