Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Engineering Specification
Electrical

EP 06 00 00 01 SP

SYSTEM SUBSTATION BATTERY & BATTERY CHARGER

Version 4.0

Issued May 2013

Owner:	Chief Engineer, Electrical		
Approved by:	Neal Hook Chief Engineer Electrical	Authorised by:	Neal Hook Chief Engineer Electrical

Disclaimer

This document was prepared for use on the RailCorp Network only.

RailCorp makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version of the document as in use by RailCorp.

RailCorp accepts no liability whatsoever in relation to the use of this document by any party, and RailCorp excludes any liability which arises in any manner by the use of this document.

Copyright

The information in this document is protected by Copyright and no part of this document may be reproduced, altered, stored or transmitted by any person without the prior consent of RailCorp.

Transport RailCorp NSW

Engineering Specification

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Document control

Version	Date	Summary of change
	November 2001	Last Technical Review
3.0	May 2010	Application of TMA 400 format.
4.0	May 2013	• Document number changed from EP 06 01 00 01 SP to EP 06 00 00 01 SP. • Document title changed to include "Battery Charger" • Updated list of RailCorp and Australian standards • Updated the definitions. • Added tables 1 & 2 to summarise the technical requirements of the battery and charger. • Specified that the battery type shall be either gel or flooded cell. • Amended the technical requirements for battery chargers. • Added section on commissioning. • Added Appendix A – RailCorp Substation battery loads. • Added Appendix B – Maintenance Philosophy • Added Appendix D – Construction and Installation • Amended the tender schedules to include sealed batteries, battery charger details and battery stand details. • Added Appendix F – Requirements for technical Aspects of Evaluation.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Contents

1 Introduction 5
2 Scope and Application 5
2.1 New Locations 5
2.2 Existing Locations 5
3 References 6
3.1 Australian Standards 6
3.2 RailCorp Specifications 6
3.3 International Standards 6
3.4 Drawings 6
4 Definitions & Abbreviations 7
5 Battery System Functional Characteristics 8
5.1 General 8
6 Whole-of-Life Cost 8
7 Battery Technical Characteristics 9
7.1 Summary of Requirements 9
7.2 Table of Technical Characteristics. 9
7.3 Battery Capacity 10
8 Battery Accessories 10
9 Dual-Battery Traction Substations 10
10 Installation 10
10.1 Battery Rooms 10
10.2 Battery Cabinets 11
10.3 Battery Location 11
10.4 Dual Battery requirements 11
11 Battery Charger 11
11.1 Battery Charger Technical Characteristics 12
11.2 Supply Source Harmonics 13
11.3 Alarms & Indications 13
11.3.1 SCADA Alarms & Indications 13
11.3.2 Local Alarms & Indications 13
11.3.3 Charger Settings 13
12 Tests 14
12.1 Battery Type Tests 14
12.2 Battery Acceptance Tests 14
13 Commissioning of Battery and Battery Charger 14
14 Integrated System Support Requirements 15
14.1 Integrated Support Objectives 15
14.2 Equipment Supplier Deliverables 15

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix A **RailCorp Substation Battery Loads** **16**
Appendix B **Construction and Installation Requirements** **18**
Appendix C **Battery Technical Schedule** **19**
Appendix D **Maintenance Philosophy** **25**
Appendix E **Request for Tender (RFT) Checklist** **26**
Appendix F **Requirements for Technical Aspects of Tender Evaluation** **27**

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

1 Introduction

This document specifies the whole-of-life performance requirements for a stationary battery and charger for use in RailCorp system substations. System substations include traction substations, sectioning huts and high voltage substations.

The stationary battery is used to maintain the dc electrical supply for essential equipment within the substation in the event of loss of the normal ac supply or failure of the battery charger.

2 Scope and Application

The primary purpose of this document is to enable the procurement of stationary battery and battery charger for use in new RailCorp system substations.

The stationary battery covered by this Specification is used in system substations to provide a dc supply to substation equipment. This dc supply is generally used for control functions, indications (SCADA) and protection relay operation.

The most common battery voltage used in RailCorp system substations is 125V dc nominal. A nominal 50V dc system is also common in some areas of the RailCorp network. In both cases the battery system is isolated from earth.

2.1 New Locations

The requirements of this document apply to new RailCorp system substations. The battery and charger for new locations shall be procured from the same supplier to ensure compatibility. This requirement does not mandate that the battery and charger are from the same manufacturer.

2.2 Existing Locations

Existing RailCorp locations have a variety of factors that are required to be considered before replacing the existing battery or charger. These include:

- Type of existing battery charger and suitability for proposed replacement battery.
- Environmental conditions that are outside manufacturers' recommended operating temperature.
- Capacity of existing battery and assessment of required capacity (due to equipment changes).
- Suitability of existing battery stands.

These factors must be addressed and documented prior to replacement of either the battery or charger.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

3 References

The following Australian and International Standards are either referenced in this specification or can provide further information.

3.1 Australian Standards

AS 2676.1 – 1992 *Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings: Vented cells.*

AS 2676.2 - 1992 *Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings: Sealed cells.*

AS 3011.1 - 1992 *Electrical installations - Secondary batteries installed in buildings - Vented cells.*

AS 3011.2 - 1992 *Electrical installations - Secondary batteries installed in buildings - Sealed cells.*

AS 4029.1 - 1994 *Stationary batteries - Lead-acid: Vented type.*

AS 4029.2 - 2000 *Stationary batteries - Lead-acid: Valve regulated sealed type.*

AS 4029.3 - 1993 *Stationary batteries - Lead-acid: Pure lead positive pasted plate type.*

AS 4044 – 1992 *Battery chargers for stationary batteries*

AS 60529 – 2004 *Degrees of protection provided by enclosures (IP Code)*

AS/NZS 61558.1 – 2008 *Safety of Power Transformers, Power Supplies, Reactors and Similar Products - General requirements and test*

AS/NZS 61558.2.4 – 2009 *Safety of power transformers, power supplies, reactors and similar products for supply voltages up to 1 100 V- Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers*

AS/NZS 61558.2.17 –200 *Safety of power transformers, power supply units and similar - Particular requirements for transformers for switch mode power supplies*

3.2 RailCorp Specifications

EP 00 00 00 12 SP *Electrical Power Equipment – Integrated Support Requirements*

EP 00 00 00 13 SP *Electrical Power Equipment – Design Ranges of Ambient Conditions*

EP 00 00 00 15 SP *Common Requirements for Electric Power Equipment*

3.3 International Standards

IEEE Std 485 - 2010 *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations.*

3.4 Drawings

The following drawings can provide further information:

EL0138270 Substations/Section Huts, 120V Battery Isolator Panel

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

4 Definitions & Abbreviations

ACCB	AC circuit breaker
Ageing Factor	A factor of 1/0.8 to ensure that a battery can still supply the required capacity at the end of its design life.
Battery	A unit consisting of one or more cells connected in series, parallel, or series-parallel arrangement to supply the voltage and current requirements of the connected load.
Capacity	The total number of ampere-hours that can be withdrawn from a fully charged battery at a specific discharge rate and electrolyte temperature, and to a specific end-of-discharge voltage.
C_{10}	Battery capacity in Ampere-hours at the 10-hour discharge rate and at the Reference Temperature, starting from full charge defined by float voltage 2.25V (typical) per cell and ending at 1.80V per cell.
Cell	An assembly of electrodes and electrolyte which constitute the basic unit of a battery. The cell is characterised by a nominal 2V potential.
CEE	Chief Electrical Engineer
DCCB	Direct current circuit breaker
Design Life	The period during which a fully charged battery is capable of delivering at least 80% of its capacity
Design Margin	A factor of 1.2 applied to the SLC which ensures additional battery capacity above requirements to allow for unforeseen additions to the dc system and less than optimum operating conditions due to improper maintenance or recent discharge
Full Charge	The capacity attained by a battery at the Reference Temperature when float-charged at 2.25V (typical) per cell
Full Float Operation	Operation of a dc system with the battery, battery charger, and load all connected in parallel and with the battery charger supplying the normal dc load plus any charging current required by the battery. (The battery will deliver current only when the load exceeds the charger current).
Isc	The short-circuit current at the Reference Temperature of a new, fully-charged battery
Lead Acid (flooded cell)	Lead acid, liquid electrolyte (vented battery)
MSLC	Maximum standing load current. SLC x Design Margin of 1.2 (20%)
REC	Rail earth contactor
Reference Temperature	The standard temperature for stating cell capacity, which is 20°C in this specification.
RFT	Request for Tender
SCADA	Supervisory Control and Data Acquisition system
SCR	Silicon controlled rectifier

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Self Discharge	The amount of capacity reduction occurring per unit of time due to internal chemical reactions (local action).
SLC	Standing Load Current. The average battery current drawn by the substation equipment during 10 hours standby operation.
Temperature Correction Factor	A cell size correction factor to allow for reduced capacity at the lowest expected temperature. Typically 1/0.80 for –5°C.
VRLA	Valve-regulated lead-acid (sealed battery).

5 Battery System Functional Characteristics

5.1 General

The battery system shall be suitable for standby service in full float operation. This is where the system is operated with the battery, battery charger and load connected in parallel and the charger supplying the normal dc load plus charging current drawn by the battery.

Principal loads on the battery dc system are:

- holding coils in 1500V DCCB's
- controls and numerical protection relays in switchgear
- SCADA equipment
- rail-earth contactor (dependant on type) if installed
- random momentary operations of high voltage switchgear
- load of emergency dc lighting

6 Whole-of-Life Cost

The selection of the battery shall be made on the basis of minimising the whole-of-life cost. The following factors must be considered in determining this:

a) Initial purchase price

b) Estimated lifetime of batteries

c) Cost of inventory spares

d) Cost of any special tools

e) Cost of manuals

f) Cost of installation

g) Cost of maintenance

h) Cost of removal and disposal

i) Cost of changes to the Technical Maintenance Plan & Service Schedules or the creation of a new TMP and schedules.

If the batteries are being procured with a battery charger, the whole-of-life cost of the batteries and charger shall be added before comparison.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

7 Battery Technical Characteristics

7.1 Summary of Requirements

The battery shall supply the dc load of the system substation when there is no output from the battery charger. This may be due to loss of the ac supply to the substation or a fault in the battery charger or its supply.

Under these conditions, the battery shall supply the substation standing load for 10 hours, starting from full charge (defined by manufacturers float voltage per cell). At the end of the 10 hour period the battery shall be able to perform any high voltage circuit breaker closing operations to restore supply to the battery charger that may be necessary whilst still carrying the standing load.

7.2 Table of Technical Characteristics.

The following table summarises the technical characteristics and requirements of the battery.

	Requirement	***Comment***
Battery Type	VRLA (gel)	Suitable for locations that are not subject to high temperatures.
	Lead acid (flooded cell)	Suitable for all locations – requires a dedicated battery room.
Cell Orientation	Installed vertically or horizontally (for gel type).	Orientation will depend on installation requirements.
Temperature Operating Range	-5°C to +50°C	Refer to RailCorp Standard EP 00 00 00 13 SP
Minimum Design Life	15 years (based on 20°C ambient)	
Number of cells	**<u>125V battery</u>** 56 cells (~2.25V per cell) 28 cells (~4.5V per cell) 19 cells (~6.75V per cell) **<u>50V battery</u>** 24 cells (~2.25V per cell) 12 cells (~4.5V per cell) 8 cells (~6.75V per cell)	Cell voltage will depend on the required battery capacity. All cells in a battery shall be of the same type and capacity.
Discharge Time	10 hrs	
Battery Capacity (C_{10}) (50V battery, 1.80V cell end volts)	To be advised in the RFT.	Sectioning Huts.
	To be advised in the RFT.	Traction Substations.
Battery Capacity (C_{10}) (125V battery, 1.80V cell & volts)	100Ah (minimum) 180Ah (minimum)	Sectioning Huts with MSLC < 3.0 Sectioning Huts with 3.0 < MSLC < 7A
	260Ah (minimum)	Traction Substations with calculated MSLC for one battery < 11A.

Table 1 - Summary of Battery Requirements

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

7.3 Battery Capacity

The minimum battery capacity is detailed in *Table 1 - Summary of Battery Requirements* and these specified capacities will cover the majority of RailCorp locations. The estimated MSLC can be calculated with reference to Table 1 - Summary of Battery Requirements and if it is greater, then the CEE representative must be consulted to determine the appropriate battery capacity.

When a substation requires two batteries both battery systems shall be identical in capacity. The equipment battery loads shall be allocated evenly across the two batteries. The MSLC can then be calculated for each battery and both batteries shall be rated to carry the larger of the two MSLC's, not the total MSLC.

8 Battery Accessories

Battery accessories, including connecting materials, bolts, nuts and bars/conductors, shall be considered as part of the battery set and shall be provided by the Supplier.

All accessories shall be of inherently corrosion resistant material, or shall be protected against corrosion. All cable and connectors shall be of sufficient gauge to carry the maximum specified load current.

9 Dual-Battery Traction Substations

Strategic substations are required to have two independent battery systems. Refer to RailCorp standard *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network* for the criteria for determining if two batteries are required.

Each battery system shall have:

- A dedicated charger for each battery
- separate dc distribution boards
- ability to parallel the dc distribution boards (via links located in the distribution boards)
- The battery, charger and associated wiring for each system shall be physically separate and installed to minimise potential damage to the other battery system when there is a fault on one system.

10 Installation

10.1 Battery Rooms

RailCorp traction substations and sectioning huts contain equipment (1500V rectifiers and 1500V DCCB's) that produce significant amounts of heat. The rooms which contain this equipment are usually not suitable for VRLA (gel) batteries as RailCorp locations are naturally ventilated and the resultant high ambient temperature causes significant reduction in life and reliability of the battery.

A dedicated battery room is one way of creating a suitable environment for VRLA (gel) batteries.

The other requirements for a battery room depend on the following:

- fire and life safety requirements
- network criticality
- a requirement as determined from a specific risk analysis

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

If a battery room is required then the battery room shall comply with *AS 3011.1* – Vented Cells. Cells are to be mounted on a stand within the battery room.

The stand shall be arranged to facilitate removal, replacement, inspection and maintenance of any individual cell without the need to remove or disconnect other cells.

The stand shall have 1.5kV insulation level to earth.

Where flooded cells are used, trays shall be provided under each cell to contain any electrolyte spillage. Stands, shelves and trays shall be of inherently corrosion resistant material, or shall be protected against corrosion.

10.2 Battery Cabinets

Where a battery room is not required and the battery is located in an area not restricted to authorised personnel then the battery shall be accommodated in a battery cabinet that complies with *AS 2676.2* and *AS 3011.2.*

The cabinet shall be designed to have the following features:

- Air flow and cooling as required by *AS 3011.2* (natural ventilation preferred)
- Front access to batteries for maintenance
- The battery cells are to be mounted to enable easy access for maintenance. This could be either horizontally (preferred) or vertically.
- 1.5kV isolation to earth is required.

10.3 Battery Location

If the battery is located in the same room as either the 1500V rectifiers or 1500V DCCB's it shall not be located directly adjacent to or directly opposite the 1500V dc busbar as the 1500V busbar and associated DCCB's are not enclosed.

The battery shall be located so that the natural air flow of the location directs any gas from the battery away from the 1500V busbar.

10.4 Dual Battery requirements

Where a location has dual batteries then the batteries, charger and associated cabling shall be arranged to avoid common mode failures. In principal this means, but not limited to:

- Battery and charger of one system shall not be located adjacent to the other battery system
- The ac supply to the chargers shall be from separate dedicated low voltage circuit breakers and the submain cables be run via separate routes
- Each system shall have its own battery isolation board/panel.
- The dc cabling from the battery isolation board/panel to the respective distribution board shall be run in dedicated independent conduit

Refer to *Appendix B – Construction and Installation Requirements* for further details relating to the installation.

11 Battery Charger

The battery that is installed in RailCorp locations is not connected electrically to the earth system. This isolation from earth shall be maintained in the charger except for high resistance connections to earth for dc earth leakage detection.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

The battery charger shall be fully compatible with the battery and for new locations the battery and charger shall be procured from the same supplier.

11.1 Battery Charger Technical Characteristics

The following table summarises the technical requirements of the battery charger.

	Requirement	Comment
Charger Type	Type 2	As defined by *AS 4044*
Technology	Switch mode type.	
Input Voltage	240/415V±10% ac or 3 wire 220V ±10% ac (unearthed system	Input voltage and the requirement for the charger to be 1Ø or 3Ø will be advised in RFT.
Frequency	50 Hz ± 2.5 Hz	
Electrical Isolation	All chargers installed in a traction substation or sectioning hut shall be equipped with an isolation transformer on the input (5kV rms for 1 minute).	If isolation can be provided by another method this will be considered.
Temperature Operating Range	-5°C to +50°C	Refer to RailCorp Standard EP 00 00 00 13 SP
Temperature Correction	Temperature correction is required to suit the type of battery installed. Battery temperature sensor required for batteries remote from charger.	Manufacturer to confirm appropriate temperature compensation is valid for the battery offered.
Float Voltage (typical)	126V for nominal 125V system 54V for nominal 50V system	Float voltage will vary with the particular cell.
Output Voltage Ranges	As per clause 6.4 of *AS 4044*	
DC Output Ratings	Charger for use with: 100Ah battery: minimum 15A 180Ah battery: minimum 25A 260Ah battery: minimum 40A	Rating based on 0.1 x C_{10} + maximum MSLC (industry standard)

Table 2 – Summary of Battery Charger Requirements

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

11.2 Supply Source Harmonics

At traction substations the source of LV ac supply to the charger is usually a 3-phase auxiliary transformer which is supplied from the 600V ac secondary winding of a rectifier transformer.

The supply from the auxiliary transformer has inherent harmonics associated with rectifier transformers (primarily 11th, 13th, 23rd & 25th harmonic). The battery charger is required to be fully operational with such harmonics present on the ac supply.

The design of each battery charger shall also be such that harmonic current emission complies with the Class A limits prescribed in AS/NZS 61000.3.2.

11.3 Alarms & Indications

11.3.1 SCADA Alarms & Indications

The following is a minimum list of alarms and indications that are required to be conveyed to SCADA.

- AC failed
- Battery Charger Fault
- Output volts low
- Output volts high
- Earth Fault detected
- Battery volts (analogue signal, 0-10mA signal corresponding to 0-150V dc typically).

These alarms shall be conveyed via voltage free contacts suitable for making and breaking at least 100mA in a 125V dc circuit or 250mA in a 50V dc circuit.

11.3.2 Local Alarms & Indications

The battery voltage and current shall be displayed on the front of the charger panel. Appropriately coloured LED indications to indicate charger status and alarm conditions shall be visible on the front panel with specific alarm details visible from the front of the charger (via LCD screen or similar).

11.3.3 Charger Settings

All adjustable settings (alarm limits, alarm reset, float voltage, temperature compensation etc) shall be able to be set from the front panel of the charger.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

12 Tests

12.1 Battery Type Tests

Tenderers shall provide copies of type test certificates or reports by a recognised testing authority for the batteries offered. Details of certificates or reports held for the following tests shall be provided with the Tender:

- Capacity at the 10 hour rate
- Suitability for floating battery operation
- Short-circuit current and internal resistance
- Charge retention (or self-discharge)
- Float current (for pure lead positive pasted plate type)
- Post seals and covers (for pure lead positive pasted plate type)
- Safety vents (for pure lead positive pasted plate type)

The information provided in the Tender shall include the test description, test authority, document registration number and year.

The test documentation shall be made available for review by RailCorp if requested during tender evaluation.

12.2 Battery Acceptance Tests

An Acceptance Test shall be carried out on every cell at the Supplier's works before delivery. The test shall take the form of a Capacity test performed in accordance with the relevant Australian Standard at the 10-hour rate to end-of-discharge voltage 1.80V per cell.

The test results shall be provided to RailCorp in the form of a certificate or report. Shipment of the cells from the works shall depend on the results being satisfactory and to RailCorp's approval.

13 Commissioning of Battery and Battery Charger

The correct commissioning of the battery and battery charger is critical in ensuring the battery is reliable and the design life of the battery is achieved. The battery charger has to be correctly commissioned to ensure the float voltage, temperature compensation, alarms and other parameters are set to the manufacturer's requirements.

All battery and battery chargers shall be commissioned and certified by the manufacturer or his representative.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

14 Integrated System Support Requirements

14.1 Integrated Support Objectives

The tenderer must establish and provide the information required to operate and maintain the equipment throughout its operational life, in a cost effective manner and to a level that is consistent with the planned operational performance and usage of the battery.

This includes:

- Specifying maintenance requirements.
- Spares support.
- Operation and Maintenance manuals.
- Training.
- Support equipment

14.2 Equipment Supplier Deliverables

The integrated support requirements are a significant deliverable in the procurement of new battery. Manuals, training, documentation and other support deliverables shall be in accordance with RailCorp Specification EP 00 00 00 12 SP Electrical Power Equipment – Integrated Support Requirements.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix A RailCorp Substation Battery Loads

The specified battery capacity (C_{10}) detailed in *Table 1 - Summary of Battery Requirements,* are minimum requirements that are valid when the calculated MSLC is less than the maximum MSLC in the table.

The values in the following table are typical values of RailCorp equipment that can be used to estimate the SLC of a 125V battery system. .The MSLC is then calculated by adding 20% to the SLC value (i.e. MSLC = SLCx1.2). This allows for additional battery loads and design variations with equipment.

When a substation requires two batteries the equipment battery loads shall be allocated evenly across the two batteries. The MSLC can then be calculated for each battery and both batteries shall be rated to carry the larger of the two MSLC's, not the total MSLC.

It should be noted that each panel of Areva/Schneider type WSA 33 kV indoor switchgear contains two separate trip coil circuits. With dual-battery traction substations it will be necessary to determine the allocation of these circuits to each battery system from the schematic diagrams.

Emergency dc lighting is to be included in the calculation of the SLC.

Equipment	mA at 125 V	Comment
Schneider/Areva WSA 33 kV Indoor Switchgear		
Feeder panel trip coil 1 circuit	70	
Feeder panel trip coil 2 circuit	70	
Bus-tie panel trip coil 1 circuit	70	
Bus-tie panel trip coil 2 circuit	40	
ILIS & IGIS busbar protection (3-panel busbar)	50	Point of supply usually in bus-tie panel
ILIS & IGIS busbar protection (5-panel busbar)	70	
33/11 kV Tx panel trip coil 1 cct.	120	
33/11 kV Tx panel trip coil 2 cct.	60	
Rectifier Tx panel trip coil 1 circuit (DCCB closed)	1800	Rectifier DCCB is fed from this circuit and included in stated current
Rectifier Tx panel trip coil 1 circuit (DCCB open)	160	
Rectifier Tx panel trip coil 2 circuit	40	
Rectifier Tx panel – rectifier transducers auxiliary supply	100	Supply may be from trip coil 1 or trip coil 2 circuits. Refer switchgear schematics
Rectifier Tx panel – SCADA inputs supply	40	Supply may be from trip coil 1 or trip coil 2 circuits. Refer switchgear schematics
11 kV Switchgear		
Panel with trip circuit supervisory relay and numerical protection relay	50	Assumes indicating lamps OFF

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Equipment	mA at 125 V	Comment
1500 V Feeder DCCBs		
Locally-assembled Mitsubishi DCCB	185	With electronic control, Swartz 76 relay & MIU6 transducer
Fully-imported Mitsubishi DCCB	600	With relay control. Current value includes Delta I relay
Tsuda FE-23A Delta I relay	90	May be mounted on DCCB truck or in Delta I panel
Rail-Earth Contactor		
RailCorp type	0	
UGL type	360	Energised when open (normal state)
Emergency DC Lighting	360 120	Traction Substation (12 fittings) Sectioning Hut (4 fittings)
Common Equipment Panel	30	
SCADA		RS900 comms switches (usually 2) are supplied from SCADA panel and included in mA values
Foxboro SCD5200 hardware		
1-rectifier traction substation	650	
2-rectifier traction substation	1150	
3-rectifier traction substation	1650	
Sectioning hut & HV substation	350	

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix B Construction and Installation Requirements

This appendix provides information on specific installation requirements for the installation of the dc cabling, battery isolation board/panel and general connection arrangement.

DC Cabling

As the battery system is not earthed it is critical that the dc cabling is installed in a manner to ensure this is maintained. Following are specific configuration and installation requirements:

The following circuits shall be SDI cables:

- Battery to battery isolation board
- Battery isolation board to respective dc distribution board
- Paralleling cables between dc distribution boards in a dual battery location

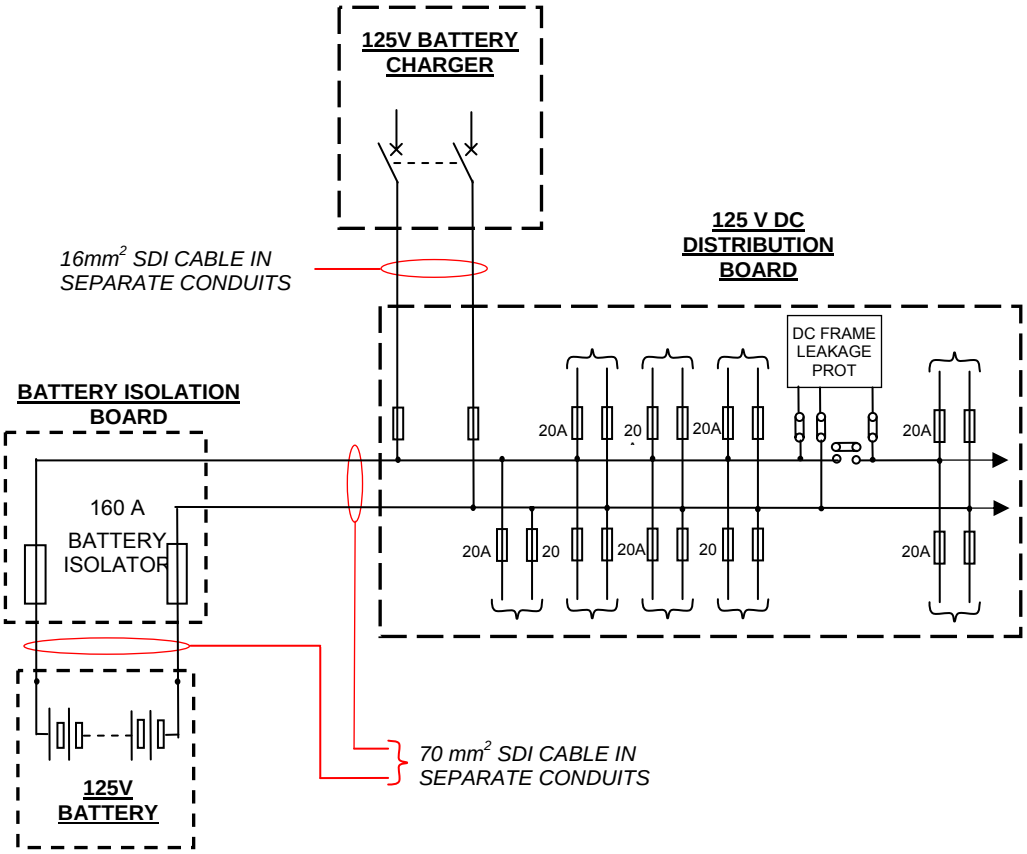
All cables originating from the distribution board to equipment shall be 2 core (no earth wire).

The following cables shall be installed in separate rigid conduit, with respective positive and negative adjacent to each other:

- The dc cables from the battery to the battery isolation board.
- The dc cables from the battery isolation board to the dc distribution board
- The dc paralleling cables between dc distribution boards in a dual battery location

DC Connection

The following diagram illustrates the required connection arrangement.



Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix C Battery Technical Schedule

Tenderers shall provide the following technical information:

Battery Detail – Sealed Cell

Manufacturer Details:

Manufacturer	…….....	
Type of battery	…….....	
Can the battery be installed horizontally?	…….....	
Manufacturer's type/model designation	…….....	

Battery Details

Total number of cells	…….....	
Manufacturer's nominal capacity	…….....	Ah
Published design life at 20°C	…….....	Yrs

Actual capacity at float voltage 2.25 V per cell, end-of-discharge voltage 1.80V and 20°C (Ah):

10 hour rate	…….....	Ah
3 hour rate	…….....	Ah
1 hour rate	…….....	Ah

Actual capacity at float voltage 2.25 V per cell, end-of-discharge voltage 1.80 V and 50°C (Ah):

10 hour rate	…….....	Ah
3 hour rate	…….....	Ah
1 hour rate	…….....	Ah

Method of intercell connection	…….....	
Maximum & minimum rated ambient temperatures (°C)	…….....	
Maximum acceptable recharge rate (% C_{10})	…….....	
Short-circuit current at full charge and 20°C	…….....	A

Cell Details

Nominal cell voltage	…….....	V
Number of positive plates per cell	…….....	
Number of negative plates per cell	…….....	
Type of positive plate (Flat/Tubular etc)	…….....	
Internal resistance of cell at full charge at 20°C	…….....	mΩ
Self discharge over 90 days at 20°C (%)	…….....	
Actual capacity on first discharge at 20°C (%)	…….....	
Time on float to achieve 95% of rated capacity.	…….....	Days
Time on float to achieve 100% of rated capacity.	…….....	Days

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Cell container material		…….....	
Separator material		…….....	
Cell dimensions:			
	height	…….....	mm
	width	…….....	mm
	depth	…….....	mm
Weight of a cell		…….....	kg
Total weight of battery		…….....	kg

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Battery Detail – Flooded Cell

Manufacturer Details:

Manufacturer	…….....	
Type of battery	…….....	
Manufacturer's type/model designation	…….....	

Battery Details

Total number of cells	…….....	
Manufacturer's nominal capacity	…….....	Ah
Published design life at 20°C	…….....	Yrs

Actual capacity at float voltage 2.25 V per cell, end-of-discharge voltage 1.80V and 20°C (Ah):

10 hour rate	…….....	Ah
3 hour rate	…….....	Ah
1 hour rate	…….....	Ah

Actual capacity at float voltage 2.25 V per cell, end-of-discharge voltage 1.80 V and 50°C (Ah):

10 hour rate	…….....	Ah
3 hour rate	…….....	Ah
1 hour rate	…….....	Ah

Method of intercell connection	…….....	
Maximum & minimum rated ambient temperatures (°C)	…….....	
Maximum acceptable recharge rate (% C_{10})	…….....	
Short-circuit current at full charge and 20°C	…….....	A

Cell Details

Nominal cell voltage	…….....	V
Number of positive plates per cell	…….....	
Number of negative plates per cell	…….....	
Type of positive plate (Flat/Tubular etc)	…….....	
Internal resistance of cell at full charge at 20°C	…….....	mΩ
Self discharge over 90 days at 20°C (%)	…….....	
Actual capacity on first discharge at 20°C (%)	…….....	
Time on float to achieve 95% of rated capacity.	…….....	Days
Time on float to achieve 100% of rated capacity.	…….....	Days
Cell container material	…….....	
Separator material	…….....	

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Cell dimensions:

	height	…….....	mm
	width	…….....	mm
	depth	…….....	mm
Weight of a cell		…….....	kg
Total weight of battery		…….....	kg

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Battery Charge Details

Manufacturer	…….....	
Manufacturer's type/model designation	…….....	
Type designation as per *AS 4044*	…….....	
Technology of charger	…….....	
How is charged cooled?	…….....	
Rated ac input range	…….....	
Rated dc output	…….....	
How is the 5kV isolation achieved?	…….....	
Can the dc output capacity be increased at a later date? If so how?	…….....	
……..... ……..... ……..... …….....		
……..... ……..... ……..... …….....		
……..... ……..... ……..... …….....		
IP rating of charger.	…….....	
Minimum and maximum temperature range (deg ^{o}C)	…….....	
Overall dimensions H x W x D	…….....	mm
Weight	…….....	Kg
Time to charge the battery from end of discharge voltage to full charge.	…….....	hrs

Battery Cabinet Details (where applicable)

Overall dimensions H x W x D	…….....	mm
Are cells mounted vertically or horizontally?	…….....	
Does the cabinet comply with *AS 2676.2* and *AS 3011.2*?	…….....	
Stand and shelf material	…….....	
Stand and shelf finish	…….....	
Tray material	…….....	
Are special tools required to remove/install the cells?	…….....	
Are there any special ventilation requirements?	…….....	

Battery Stand Details (where applicable)

Overall dimensions H x W x D	…….....	mm
Are cells mounted vertically or horizontally?	…….....	
How is the 1.5kV isolation achieved?	…….....	
Stand and shelf material	…….....	
Stand and shelf finish	…….....	
Tray material	…….....	

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Additional Technical Information Required

- Discharge tables showing capacity versus discharge current
- Life versus temperature curve
- Float voltage versus temperature curve
- Capacity versus temperature curve
- Charging data, including current, voltage and % recharge versus time curves
- Drawings of battery stand (if applicable).
- Drawings of battery cabinet (if applicable).

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix D Maintenance Philosophy

This standard has been written based on the following maintenance philosophy.

- The battery system when commissioned has all required alarms fully tested and the alarms available at EOC to enable notification of relevant maintenance staff.
- Maintenance staff are notified when EOC receive an alarm and respond in a timely manner.
- The battery charger is compatible with the battery.
- The battery and charger is installed in an environment that does not exceed the environmental conditions as advised by the manufacturer.
- When there is a cell failure within a battery then the cell will be replaced with the identical type and capacity.
- The battery manufacturers recommended maintenance procedures are incorporated in the RailCorp TMP for the battery and the associated service schedule.
- Maintenance is completed as per the TMP.
- The battery is replaced at the end of its life. This is determined from the recorded maintenance activities and in consultation with the manufacturer as required.

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix E Request for Tender (RFT) Checklist

Application

The following material is for guidance in the preparation of a Request for Tender for this type of equipment. This checklist itself is not intended to directly form part of any contract.

There is a large variation in battery room dimensions within the various system substations in the RailCorp network. The RFT shall advise whether the battery is to be installed in a battery cabinet or whether in a battery room and stands are to be supplied with the battery. In the latter case, a layout drawing of the battery room must be included with the RFT.

This section is to be read in conjunction with the RFT checklist in RailCorp Specification EP 00 00 00 12 SP.

Information To Be Sought From Tenderers

- Technical Schedule at Appendix C.
- List of Type Test certificates held as per section 12.1 Battery Type Tests.
- Integrated Support Information as per RailCorp Specification EP 00 00 00 12 SP.
- Whole-of-Life Costing Information as per section 5.2
- List of departures from Specification.
- Draft Manufacture and Delivery Programme for assessment.
- Manufacturer's product literature including background information, experience list, physical description, dimensions, catalogue numbers and selection tables
- Discharge tables showing capacity versus discharge current

Information To Be Provided to Battery Suppliers

The following information must be advised in the RFT for each rating of battery to be procured or, in the case of a Supply Agreement, at placement of Order:

Item	Information
Are sealed batteries excluded due to charger type?	Y/N
Nominal battery voltage	125V or 50V
Nominal capacity C_{10}	Ah
Number of cells in series (if non-standard)	
Are stand and shelves to be supplied with battery? If yes, attach battery room layout drawing	Y/N

Superseded by T HR EL 06001 SP v1.0, 26/05/2021

Appendix F Requirements for Technical Aspects of Tender Evaluation

Evaluation of tenders

The Chief Engineer Electrical requires that persons evaluating the technical aspects of this tender have sufficient technical competence for the task.

Tender evaluation committees shall forward details of persons evaluating the technical aspects of the tender to the Chief Engineer Electrical for concurrence. This will normally be in the form of an email and is to include sufficient detail of the tender and the person to enable the Chief Engineer Electrical to satisfy themself of the merits of the evaluating person. A minimum of 4 weeks notice is required prior to the evaluation of the Tenders.

The Chief Engineer Electrical will advise only if the person is considered unsuitable for the technical evaluation.

Acceptance of product

A number of the specifications require acceptance of product at both the factory and at site. The purchaser is to advise the Chief Engineer Electrical the details of the person carrying out the acceptance testing for the concurrence of the Chief Engineer Electrical. A minimum of 4 weeks notice is required prior to the evaluation of the acceptance testing.

The Chief Engineer Electrical will advise only if the person is considered unsuitable for the acceptance testing.

The Chief Engineer Electrical reserves the right to nominate a representative to review and/or attend such acceptance.

Record Keeping

Where product is purchased against this specification, the Chief Engineer Electrical requires that relevant detail be provided so that it can be logged against this specification.

For RailCorp purchases, the tender evaluation committee shall advise the Chief Engineer Electrical the RailCorp registered file details containing the tender evaluation for future referencing. This is normally a TRIM reference.

Where this specification is utilised by parties external to RailCorp (Alliance parties, etc) then copies of all relevant technical information and evaluation shall be forwarded to the Chief Engineer Electrical for filing against the specification. In addition copies of selected commercial information pertaining to the ongoing support of the product as follows is also required.

- Warranty details
- Spare parts and associated availability
- Product support information.