Standard

DC Distribution System Standard

R522693

Version 1.0, June 2018

Tasmanian Networks Pty Ltd (ABN 24 167 357 299)

Authorisations

Action	Name and title	Date
Prepared by	Michael Verrier, Senior Asset Strategy Engineer	June 2018
Reviewed by	Santosh Dhakal, Asset Engineer	June 2018
Authorised by	Darryl Munro, Asset Strategy Team Leader	June 2018
Review cycle	30 months	

Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Minimum Requirements

The requirements set out in TasNetworks' documents are minimum requirements that must be complied with by all TasNetworks team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

Record of revisions

Section number	Details
Entire doc	Copied over verbatim from superseded Transend D03/5622 to TasNetworks template. Updated Transend to TasNetworks document reference numbers where known.
Authorisations	Review cycle changed from 60 months to 30 months.

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1 General

1.1 Purpose

To define the requirements for the DC distribution system under the responsibility of Tasmanian Networks Pty Ltd (hereafter referred to as TasNetworks).

1.2 Scope

This standard applies to all DC distribution systems under the responsibility of TasNetworks and must be read in conjunction with the DC distribution system drawings and other documentation available from TasNetworks (refer Section 1.6).

This standard contains requirements for design, engineering, manufacture, construction, testing at manufacturer's works, secured packaging, supply, transportation, delivery to site, testing and commissioning with complete documentation of DC distribution systems and is to be applied to new installations as well as redevelopment of part or all of existing installations.

1.3 Objective

TasNetworks requires design, construction, installation and commissioning of equipment and services as covered in this standard to ensure:

(a) that relevant Australian legal requirements are met;

(b) that the requirements of the National Electricity Rules (NER) are met;

(c) personnel, public safety and environmental hazards are identified, analysed and eliminated or control measures adopted;

(d) safety of TasNetworks' assets;

(e) ease in operation and maintenance;

(f) reliability of the electricity transmission system;

(g) minimum disruption to the electricity transmission system following a fault;

(h) that the requirements of TasNetworks' corporate plan are met; and

(i) that the exposure of TasNetworks' business to loss is minimised.

1.1 Certificate of conformance

(a) Before any new and/or modified DC distribution system is put into service in TasNetworks' system, a certificate of conformance to this standard must be submitted to TasNetworks. The certificate of conformance must be duly supported with documents, drawings, test results, test reports, test certificates, completed check lists and other documents as applicable. Where TasNetworks has

approved a deviation to specific requirements of this standard, all such approvals must be included with the certificate of conformance.

(b) TasNetworks will supply blank forms for certificate of conformance, to be completed by the Contractor.

(c) The DC distribution system will be put in service only after TasNetworks has accepted the certificate of conformance.

1.1 Precedence

Any apparent conflict between the requirements of this standard and the law, mandatory requirements, industry standards, project specifications, non-statutory standards or guidelines, and any other associated documents should be brought to the immediate attention of TasNetworks for resolution and no action must be taken that might result in a breach of law or mandatory standard.

Where there may be a conflict between the requirements of this standard and any:

(a) law, mandatory requirement or industry standard, then that law or statutory requirements will prevail over this standard;

(b) non-mandatory standard, or guideline, then this standard will prevail over that standard or guideline; and

(c) project specification, then the contract documentation will prevail over this standard.

Except that, the selection of equipment, design and all works associated with the temporary earthing of substation equipment must conform to the requirements as specified in document R522687, General Substation Requirements Standard.

Approval for a deviation to this standard may only be accorded if it does not reduce the quality of workmanship, pose a safety risk to personal or equipment and does not deviate from the intent of this standard. Deviations if any must be specifically requested, and approved in writing by TasNetworks, Leader Asset Strategy and Performance.

1.1 References

As a component of the complete specification for a system, this standard is to be read in conjunction with other standards and documents as applicable. In particular this includes the project specifications and the following:

1.1.1 Key references

Standard DC Distribution System Design Drawings – Drawing Index (For complete list of reference drawings)	TSD-DI-809-0014-001
Substation Standard Drawing, 110MCRII3P060 Battery Charger	TSD-SH-806-0014-001
DC Distribution System information to be provided with tender	R579288
DC Distribution System deliverables	R579287

1.1.2 Other references

	Wiring Rules	AS/NZS 3000:
R590634	Substation Civil Design and Construction Standard	
R246439	SCADA System Standard	

R522687	General Substation Requirements Standard
R246497	Testing, Commissioning and Training Standard
R590630	HV and LV Cable Systems Standard
R565983	High Voltage System Standard
R522692	Substation Lightning Protection and Earthing Standard

1.2 General requirements from DC distribution system

The DC distribution system must:

(a) have adequate facilities to enable any component to be removed from site without disruption to adjacent equipment; and

(b) enable maintenance of the system to be performed safely and efficiently, without the need for disconnection of the DC supply to any equipment.

1.1 Project specific requirements

Project specific requirements for the DC distribution system will be listed in the project specifications consistent with the conditions as specified in Section 2 and with a battery rated capacity compliant with the requirements as detailed in Section 3.1.

The DC distribution system design must be based on system parameters and requirements as stated in document R522687, General substation Requirements Standard.

1.2 Service conditions

Environmental conditions and any specific design criteria for particular works will be stated in the project specifications. Minimum service conditions for DC distribution systems are stated in document R522687, General Substation Requirements Standard.

All equipment must be capable of operation at its specified rating without assisted means, for example, forced cooling to achieve the rated capacity is not permitted.

1.3 Performance

DC distribution systems must ensure reliability, security and redundancy.

The selection of the equipment constituting the DC distribution system must be appropriate to satisfy the design criteria and to meet or exceed the specified performance.

2 DC distribution system

Refer Standard DC Distribution System Design Drawings (refer Section 1.6).

A DC distribution system must comprise of two independent DC distribution systems (system 'A' and system 'B'), each system making provision for the following distinct elements:

(a) a battery

(b) a battery charger

(c) a fused switchboard

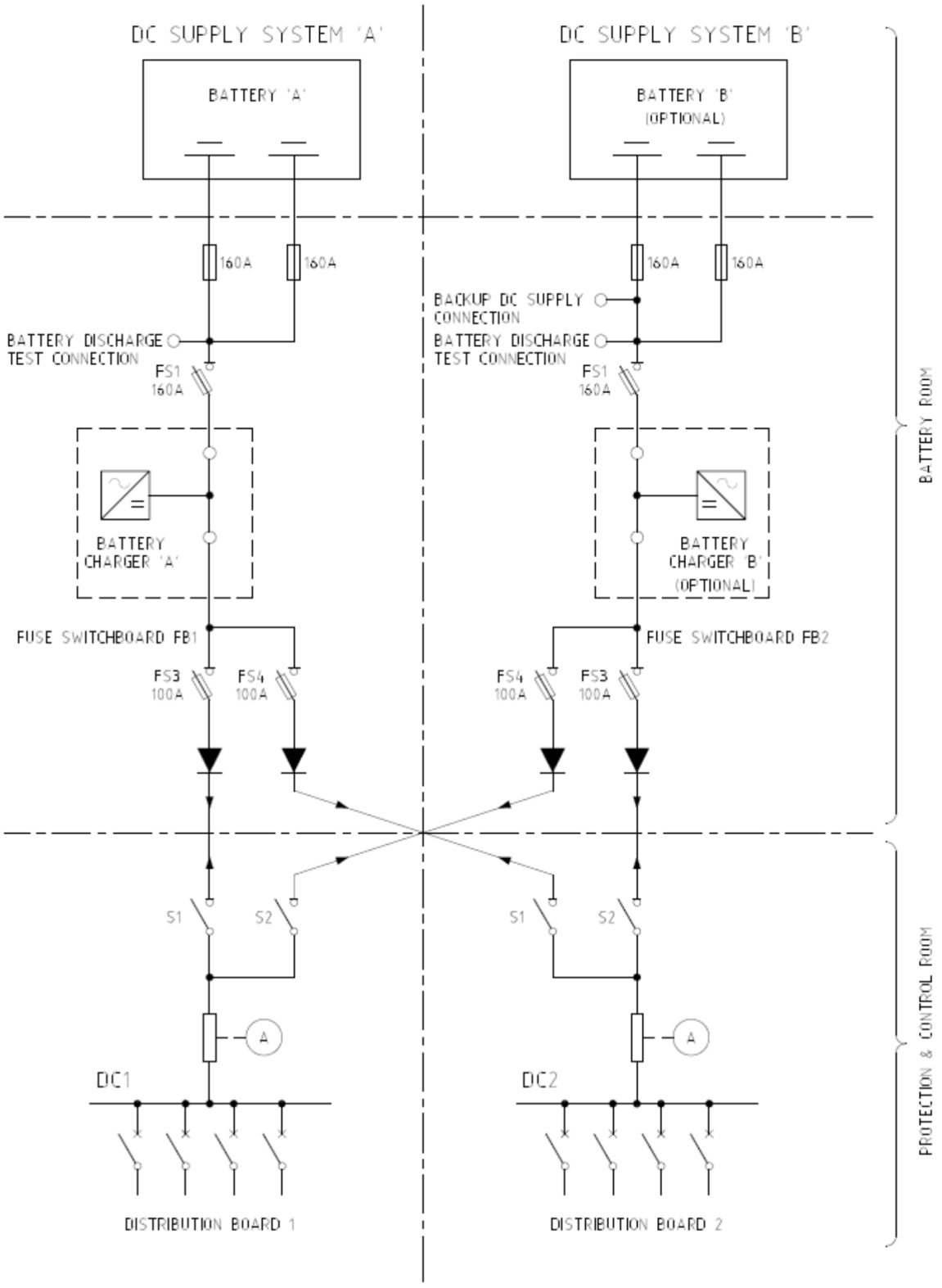
(d) a distribution board

(e) associated interconnections

This design allows the DC distribution system to be upgraded from a single to a dual DC distribution system simply by installing an additional battery and battery charger (battery 'B' and battery charger 'B').

A DC distribution system one-line diagram is shown in Figure 1.

Figure 1 DC Distribution System one-line diagram



2.1 Application of DC distribution system

The DC distribution system must be used for all DC supply requirements, including:

(a) protection circuits;

(b) switchgear trip and close circuits;

(c) indications, alarms and Supervisory Control and Data Acquisition (SCADA) circuits;

(d) auxiliary and emergency lighting;

(e) switchgear spring charge motor circuits and motorised disconnectors;

(f) security and fire detection systems; and

(g) other applications as required.

2.1 DC distribution concept

The whole DC distribution system shall comprise of as a minimum:

(a) an 'A' and 'B' DC supply system;

(b) the 'A' battery and associated battery charger;

(c) two fuse switchboards;

(d) two DC distribution boards;

(e) an emergency mobile connection panel; and

(f) associated interconnections.

The minimum system requirement stated in 2.2 (a) through to (c) is not a full duplicate system. The further addition of optional 'B' battery and charger is required to complete a full duplicate system. The minimum requirement or the full duplicate requirement will be stated in the specific project requirements.

Both 'A' and 'B' DC supply systems are connected together via a diode system to ensure the security of the system in the event of a system fault or malfunction in one DC supply system.

The 'B' DC supply system will have the facility to connect to an outdoor mobile DC supply connection box consisting of fuses and a CAVOTEC PC2-WX04-0250 DC socket.

(g) The DC loads must be designated as either of two categories, namely:

  (i) Category 1: DC loads whose functionality is duplicated and other equipment can perform exactly the same function. Typical examples of such DC loads are:

    - protection, where protection function of one relay can be performed by a duplicate relay without loss of any functionality; and
    - trip coils where each duplicate protection initiates the tripping of duplicate trip coils;

  (ii) Category 2: DC loads whose functionality is not duplicated. Typical examples of such DC loads are:

    - protection, where protection function of one relay cannot be performed by another relay without loss of performance;
    - close coils where only single close coils are provided;
    - spring charging circuits;
    - metering and bay controllers;
    - SCADA equipment that is not duplicated; and
    - emergency lighting;

(h) Category 1 DC loads must be supplied from the DC distribution boards of alternate DC supply systems. Example: main protection 'A' supplied from System 'A' DC bus and duplicate protection 'B' supplied

from System 'B' DC bus (assuming main protection 'A' and duplicate protection 'B' are complementary);

(i) Category 2 DC loads must be supplied from either the 'A' or 'B' DC distribution system. However, the principle that must be adhered to is that the upstream backup protection must be supplied from the alternate DC supply system eg. feeder protection supplied from system 'A' and associated transformer LV over-current from system 'B'. If the condition for upstream backup protection is not applicable then the remainder of Category 2 loads must be distributed such that the MCBs are distributed evenly across the two panels. This will ensure that the panels don't become congested. As far as possible the loads must also be distributed evenly across panels;

(j) all DC loads must be supplied direct from the DC distribution board unless otherwise agreed in writing by TasNetworks. Should sub-distribution boards be required it will be stated in the project specifications;

(k) each DC load must be supplied from a separate dedicated circuit, with the exception of HV switchboards where supplies shall be grouped as per Section 4.3.2 of R565983, High Voltage System Standard; and

(l) separate DC supplies to DC loads must use separate cables.

2.1 Design requirements for DC distribution system

Refer to Standard DC Distribution System Design Drawings (refer Section 1.6).

The DC distribution system must be designed such that:

(a) adequate ventilation is provided to ensure the DC distribution system can operate at rated capacity within specified temperature limits in accordance with manufacturer's instructions;

(b) it is appropriately rated to withstand the prospective fault current the battery and/or battery charger is capable of delivering for at least one second or the time taken for the short circuit protection device to operate, whichever is greater;

(c) it is adequately rated to withstand the fault rating at site;

(d) the loss of a DC supply must not lead to a loss of supply to any DC load;

(e) failure of a component on a circuit does not affect any other circuit;

(f) cable entry into the DC distribution board is via a gland from the top or bottom or both; and

(g) DC cables are clearly identified and segregated from any other supply circuits.

Specific design parameter requirements for the DC distribution system are shown in Table 1.

Table 1 Specific technical parameters for DC Distribution System

Sr No.	Description	Unit	Requirement
1	**Requirements for DC Distribution System**		
1.1	Nominal voltage	V	125
1.2	Earthing	-	Unearthed DC
1.3	Insulation Characteristics:	-	
1.3a	Impulse withstand voltage between all circuits and earth and between separate circuits (to AS/NZS 61439.1)		5 kV 1.2 / 50 microseconds
1.3b			2 kV / 50 Hz for 1 minute

Sr No.	Description	Unit	Requirement
	Insulation resistance between all circuits and earth and between separate circuits (to AS/NZS 61439.1)		
1.4	Frequency Emissions	-	Protection to restrict radio frequency currents
2	**Specific Requirements for Battery**		
2.1	Permissible system operating voltage variation	%	+10/-15% of nominal float voltage
2.2	Battery Cell type	-	58 cells type VRLA minimum 130Ah, C10

3 Battery

3.1 Battery capacity

Each battery must be rated to supply full substation DC load allowing for 30 per cent contingency for future load and aging, for an 8 hour period, with the battery charger out-of-service. The rating of the battery must also cater for other load requirements as stipulated in the project specifications.

3.2 Battery enclosure

The battery must be housed in a steel cabinet or rack design for the intended purpose. The design of the steel cabinet or rack requires approval by TasNetworks prior to manufacture and shall:

(a) be adequately vented, designed to a degree of protection by enclosure of IP41 (for indoor climatically controlled installations);

(b) cabinets to be painted APO Ripple Grey;

(c) racks to be painted satin black;

(d) include a suitably placed pocket to contain battery manual, test records and associated schematics;

(e) designed for ease of capacity testing;

(f) have maximum and minimum shelf heights of 1600 mm and 300 mm;

(g) have cells that can be mounted in any designed orientation and come with a protective cover to ensure against accidental shorts; and

(h) labelled on the front, stating as a minimum the battery designation (based on TasNetworks' device numbering system), battery specifications, cell information, information that relates battery to its documentation and other relevant information. The label must be in conformance with requirements stated in document R522687, General Substation Requirements Standard.

3.1 Battery labelling

Each battery cell (cover and cell) must be:

(a) identified with a traffolite label which is mechanically affixed to the battery or rack; and

(b) labelled sequential, beginning with the number one at the positive end of the battery.

3.1 Battery installation location

The proposed location of the battery must be submitted to TasNetworks for acceptance and approval.

The battery installation must consider floor loading prior to installation. A design review must be submitted to TasNetworks for approval.

The battery must be positioned to minimise the length of unprotected cables between the battery and its fuse switchboard.

4 Fuse switchboard

4.1 Battery protection

Refer to Standard DC Distribution System Design Drawings (refer Section 1.6).

The battery protection system must be designed such that:

(a) each string of cells must have primary fuse protection graded to blow within one second of a fault occurring;

(b) secondary fuses must grade with the primary fuses, in the event of any distribution board fault the relevant secondary fuses will blow isolating the fault but maintaining security on the remaining system;

(c) back-to-back diode arrangements or equivalent must be provided such that faults on any one DC supply system does not affect the other DC supply system;

(d) the system must have a battery discharge connection point;

(e) the system shall have a backup DC supply connection point;

(f) the battery protection must be separate from the distribution board and adjacent to its own associated battery; and

(g) the battery protection must be installed within an individual fuse switchboard for each DC system (A and B).

4.1 Fuse switchboard enclosure

Refer to Standard DC Distribution System Design Drawings (refer Section 1.6).

The fuse switchboard must:

(a) have a 'Rittal' cabinet enclosure with a degree of protection of IP41 as a minimum and must:

(i) be adequately ventilated;

(ii) have similar depth and height dimensions to the battery cabinet;

(iii) be painted RAL 7032 grey colour;

(iv) be designed to include a suitable pocket on the inside of the front door to contain the schematic drawings; and

(v) be labelled in accordance with R522687, General Substation Requirement standard;

(b) be of dead front type with a glazed front for visual inspection of the circuits and monitoring of instrumentation);

(c) include provision for access to all components from the front;

(d) have the escutcheon:

(i) hinged on one side;

(ii) device identification labels; and

(iii) switch handles fitted on escutcheon;

(e) have generous wiring space for the connection of incoming cable terminations; and

(f) have cable entry from the bottom in general but allow for top entry.

5 Battery charger

5.1 Battery charger design

Refer to standard DC Distribution System Design Drawings (refer section 1.6) and TSD-SH-806-0014-001, MCR-II Battery Charger

The battery charger must be designed such that:

(a) it is appropriate to the type and characteristics of the battery;

(b) with the battery disconnected, it is capable of operating without damage;

(c) it is capable of recharging a fully discharged battery within 5 hours and at the same time be able to supply the full substation DC load plus still make allowance for a further 30 per cent future DC load growth;

(d) it is capable of maintaining the battery in float charge condition and at the same time able to supply the full substation DC load plus 30 per cent future DC load;

(e) it is capable of self restarting in the event of restoration of interrupted AC supply;

(f) continuous monitoring of the battery and battery charger health status is provided;

(g) constant DC output voltage is maintained at float charge within the variation limits of the input AC supply for the full DC output current range from 0 per cent and 100 per cent of its rated value;

(h) current limiting protection is incorporated within the battery charger to limit the maximum DC output current under short circuit conditions. The protection setting for short circuit must be manually adjustable;

(i) the initial voltage surge, upon switching on the battery charger, and for any initial current between 0 per cent and 110 per cent of the rated output value, must not exceed the set output voltage by a level which may cause damage to connected equipment;

(j) the output circuit breakers are removed from the circuit, as upstream and downstream protection fuses are fitted;

(k) any shunts in the power circuit are fault rated;

(l) all wiring shall be a minimum 16mm2 (5sec rated) to ensure that the cable size is graded with the 160A upstream fuse;

(m) on over-volts alarm the charger is tripped after a fixed time interval;

(n) temperature compensation fitted;

(o) dropping diodes are not required as on-line equalisation or boost charge shall not occur; and

(p) all DC power terminals will be stud type, and all the alarms shall be knife type.

Table 2 Specific technical parameters for battery chargers

Description	Unit	Requirement
Input AC supply nominal voltage	V	415
Input AC supply voltage variation	%	±10 of nominal voltage
Input AC supply voltage phases		Three
Input AC supply frequency	Hz	50
Power Factor	-	0.9 lagging or better
Ripple content of DC output	-	≤ 0.1%
Voltage output		125V DC nominal
Charger rating		60A rated

5.1 Battery charger enclosure

Refer to Standard DC Distribution System Design Drawings (refer Section 1.6) and TSD-SH-806-0014-001 (MCR-II Battery Charger).

Each battery charger must be:

(a) within an enclosure with a degree of protection by enclosure of IP3X (for indoor climatically controlled installations) and must be:

(i) adequately ventilated;

(ii) painted APO Ripple Grey;

(iii) designed with a suitable pocket on the inside of the front door to contain the battery charger manual and associated schematic drawings; and

(b) in the case of equipment mounted on hinged panels, all rear terminals or live parts must be effectively fitted with clear Perspex covers to provide safe working access to equipment located behind such panels.

5.1 Battery charger installation location

The location of the battery charger must be provided to TasNetworks for acceptance and approval and must be positioned to minimise the length of cabling between the fuse switchboard and its associated battery charger.

6 DC distribution board

6.1 DC distribution board design

Refer to standard DC Distribution System Design Drawings (refer Section 1.6).

The DC distribution board must be designed to:

(a) have at least two supply inputs with alarm and monitoring circuits independently for each supply input;

(b) adequate rating so as to meet the full supply capacity available from the DC supply system;

(c) have two isolators, each capable of isolating the DC distribution board from one DC supply;

(d) include 'clip-in' type lockable miniature circuit breakers for all outgoing circuits, installed on a mounting chassis;

(e) incorporate a copper busbar chassis that is fully insulated and colour coded for polarity identification;

(f) include positive and negative fixed copper busbar chassis with tunnel type terminals suitable for two pole miniature circuit breakers (MCB's) plus an auxiliary contact;

(g) ensure that all circuits are physically grouped according to their functions;

(h) include:

(i) the number of circuits required for the new / modified installation;

(ii) any existing DC circuits which will be retained in service; and

(iii) allowance for 30 per cent future load;

(i) ensure that the copper busbar chassis construction allows for the complete interchangeability of single or dual-pole breakers without alteration to chassis connections or circuit breaker mounting fixtures;

(j) a low volts alarm will be fitted and supplied from one of the MCB's; and an earth bar will be fitted to terminate screened cable specified by TasNetworks.

6.1.1 Circuit breakers

The following circuit breaker requirements must be complied with:

(a) each DC circuit must be provided with a DC rated circuit breaker for overload and short circuit protection;

(b) all circuit breakers in the DC distribution system must be appropriately graded to prevent inadvertent operation; and

(c) all MCBs (opening and tripping) must be annunciated locally and remotely (commoned).

6.1 DC distribution board enclosure

Refer to standard DC Distribution System Design Drawings (refer Section 1.6).

The DC distribution board must be:

(a) within a 'Rittal' cabinet enclosure with a degree of protection by enclosure of IP41 (for indoor installation) and must be:

(i) adequately ventilated;

(ii) painted RAL 7032 grey colour;

(iii) dimensions in mm will be 2000 height x 800 width x 600 depth plus a 100 mm plinth;

(iv) designed to include a suitable pocket on the inside of the front door to contain the DC distribution board manual, circuit designation cardholder and associated schematic drawings;

(b) be of dead front type (with glazed front for visual inspection of the circuits and monitoring instruments);

(c) suitable for access to all components from the front;

(d) supplied with an escutcheon that is:

(i) punched to accept circuit breakers for the maximum pole capacity of the chassis. Pole fillers must be provided for all spare circuit breaker positions;

(ii) hinged on one side;

(iii) with circuit identification labels;

(e) have generous wiring space for the connection of cables to circuit breakers, positive and negative bars and for incoming cable terminations; and

(f) have chassis systems that are rigidly supported at regular intervals along the length of the chassis.

6.1 DC distribution board installation location

The location of the distribution boards must be provided to TasNetworks approval.

The DC distribution board must be:

(a) physically separate from the fuse switchboard and battery chargers.

(b) installed close to the protection panels within the relay room.

(c) positioned to minimise the length of cabling between the DC distribution boards and supplied loads.

6.1 Monitoring, metering and alarms

Refer to standard DC Distribution System Design Drawings (refer Section 1.6).

6.1.1 Monitoring

All relays and monitoring equipment must be adequately electrically protected.

6.1.2 Metering

As a minimum, metering must be provided for the following:

(a) Battery charger:

(i) output DC current; and

(ii) output DC voltage;

(b) DC distribution board:

(i) load current for each incoming supply; and

(ii) DC voltage;

(c) all meters must be digital and to an accuracy of $\pm$1% of the full scale; and

(d) all meters must be adequately electrically protected.

6.1.1 Status and alarms

Refer to standard DC Distribution System Design Drawings (refer Section 1.6).

Table 3 List of alarms and remote signals from each of the two DC Distribution Systems

Sr No.	Detailed Description	Short Description	Source	Local (SCADA)	Remote (NOCS)
1	Battery charger AC supply failure	MAINS FAIL	Charger	Not Required	Not Required
2	Battery charger failure	CHARGER FAIL	Charger	Not Required	Required
3	Battery failure	BATTERY FAIL	Charger	Not Required	Not Required
4	High DC voltage	HIGH DC VOLTS	Charger	Not Required	Not Required
5	Low DC voltage (warning)	LOW DC VOLTS	Charger	Not Required	Not Required
6	No DC voltage (alarm)	DC NO-VOLT ALARM	Distribution board	Not Required	Required
7	DC earth fault	DC EARTH FAULT	Charger	Required	Required
8	DC supply circuit trip	DC LOAD MCB TRIP	Distribution board	Required	Required
9	DC Fail Common Alarm will pick-up with anyone of the alarms available on the charger	DC COMMON FAULT	Charger	Required	Not Required

Note:
Panel abbreviations must be used as a prefix to "short descriptions" in above table to distinguish between the same alarms from different panels.

6.2 Connections to SCADA and NOCS

The DC distribution system must be connected to local station SCADA system and remote NOCS as per Table 3. All works associated with SCADA must be as per the SCADA System Standard R246439, Signals and connections provided for SCADA monitoring and alarms must comply with requirements of this standard and the SCADA System Standard, R246439.

7 Cable systems

All cables and cable systems associated with DC distribution system must be in accordance with the HV and LV Cable Systems Standard, R590630.

8 Civil works

All civil works associated with DC distribution system must be in accordance with the Substation Civil Design and Construction Standard, R590634.

9 Earthing

Earthing of all equipment and works associated with DC distribution system must be in accordance with the Substation Lightning Protection and Earthing Standard, R522692.

10 Data for Asset Management Information System

TasNetworks maintains a comprehensive Asset Management Information System (AMIS) that contains all design, test results and the condition of all TasNetworks assets. The AMIS also contains maintenance regimes for all assets.

The Contractor must provide information required to maintain the currency of AMIS for each asset in standard forms. TasNetworks will provide the forms to the selected Contractor. Forms are required to be filled for new assets and for decommissioned assets.

The filled up proforma must be filled in and submitted to TasNetworks as below:

(a) design information and maintenance regime information for all assets must be submitted to TasNetworks before commencing installation on site

(b) information on test results for all assets must be submitted prior to commissioning

11 Inspection and testing

The DC system must be duly inspected and tested in accordance with relevant applicable Australian and International standards. Where tests are optional in the standards, it will be considered that these tests are required by TasNetworks, unless otherwise requested by Contractor and agreed in writing by TasNetworks at tender stage.

Testing must comply with the requirements of the Testing, commissioning and Training Standard, R246497. All inspection and test reports must be forwarded to TasNetworks for approval and acceptance. The tests will be considered as completed, only after, an approval and acceptance of test results by TasNetworks in writing. A list of the tests required to be conducted on the DC distribution systems is given below.

11.1 Type tests

All major parts such as switchgear, circuit breakers, cubicles and busbar arrangements will be required by TasNetworks to have a type test certificate. Minor items such as monitoring electronics may not be required to have type test certificates however must be approved for use by TasNetworks.

11.2 Routine tests

The following routine test requirements must be complied with:

(a) routine tests must be conducted on the complete system to prove quality of manufacture and conformance with the relevant performance requirements of the applicable Australian Standards;

(b) procedures for routine tests with supporting documentation must be submitted to TasNetworks for approval and acceptance. Routine tests will not be conducted unless the routine test procedures have been accepted and approved by TasNetworks;

(c) routine test results and certificates must be submitted to TasNetworks for approval and acceptance. Routine tests will not be considered as completed only after TasNetworks approves and accepts the test results;

(d) routine factory test results must be approved and accepted by TasNetworks prior to dispatch of equipment to site; and

(e) as a minimum, the tests stated below must be conducted.

11.1.1 Routine and special tests on battery chargers

The following routine and special will be required and test results must be provided to TasNetworks by the manufacturer:

(a) DC output characteristics

(b) current and voltage characteristics

(c) thermal rating at rated output

(d) insulation resistance

(e) instrument accurac;

(f) alarm operation

(g) output noise measurements <55 dB.

11.1.1 Routine tests on DC fuse and distribution boards

Routine tests for the boards must be done in accordance with AS/NZS 61439.1 section 11 and test results must be submitted prior to despatch.

11.1.2 Tests on monitoring and measurement equipment

The following tests will be conducted to prove:

(a) relay operation and set points;

(b) alarm contacts and circuits; and.

(c) relay and metering equipment accuracy.

11.1 Site tests on battery and battery charger

Site installation and commissioning tests must be conducted on the installed system after erection on site and before it is put into service to prove that it has not been damaged during transportation or erection. The site test procedures must be submitted to TasNetworks for approval.

Site test reports must be approved and accepted by TasNetworks prior to placing equipment in service.

As a minimum the tests stated below must be conducted:

(a) voltage measurement of each battery cell

(b) overall battery voltage measurement

(c) discharge test of the battery in accordance with manufacturer's instructions when cells are ready for such a test

(d) check all battery cell connections

(e) correct operation of battery charger in float modes

(f) correct operation of any spare parts provided with the battery and battery charger

(g) check polarity of battery voltage at each DC circuit breaker

(h) thermal image the DC supply system

(i) tests on monitoring, measurement and alarm circuits

Consider test results to be submitted to TasNetworks in a 'soft copy' format to enable ease of data population into TasNetworks' Asset Management Information System (AMIS).

12 Information to be provided with tender

Requirements for information to be submitted as part of the tender are outlined in document R579288.

13 Deliverables

Requirements for project deliverables are outlined in document R579287.

14 Hold points

The requirement of documentation is listed in the deliverable schedule in document R579287.

The hold points for DC Distribution system are:

(a) critical design information must be submitted four weeks after letters of acceptance for TasNetworks' review, comments and approval prior to procurement of equipment;

(b) detailed design documentation must be submitted prior to manufacturing or procurement of equipment, for TasNetworks' review, comments and approval;

(c) Inspection and Test Plan must be submitted two weeks prior to any testing of equipment, for TasNetworks' review, comments and approval;

(d) invitation to witness testing must be submitted two weeks prior to any testing of equipment, for TasNetworks' arrangements to witness;

(e) complete updated design documentation, operations and maintenance manuals must be submitted one week prior to Factory Acceptance Testing (FAT) for TasNetworks' preparation to attend FAT if required;

(f) final training manuals must be provided at least two weeks prior to training, for use of training team. (This must include switching and isolation procedures for testing and maintenance of DC Boards);

(g) FAT results must be submitted to TasNetworks for approval with any non-conformances identified and rectified prior to shipment;

(h) information required for AMIS pertaining to design information, test results and maintenance regimes must be submitted to TasNetworks prior to acceptance of equipment;

(i) inspection of each DC fuse switchboard, distribution board, battery charger and battery after delivery is required by TasNetworks prior to acceptance of equipment;

(j) all non-conformances as identified during pre-commissioning or commissioning tests must be completed before commencing any cut over or energisation;

(k) training must have been completed prior to energisation;

(l) All as-built documentation, operation and maintenance manuals, test results and test certificates must be submitted to TasNetworks and be accepted by TasNetworks prior to acceptance of equipment or practical completion; and

(m) certificate of conformance must be submitted to TasNetworks prior to acceptance of equipment or practical completion.

Note: Schedules and deliverables to be revised to ensure that they are complete and current.