

Title: **DISTRIBUTION GROUP'S  
SPECIFIC REQUIREMENTS FOR  
AC/DC DISTRIBUTION UNITS**

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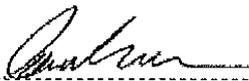
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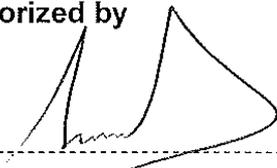
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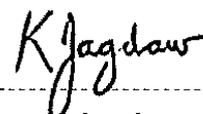
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## Content

	Page
1. Introduction .....	4
2. Supporting clauses .....	4
2.1 Scope .....	4
2.1.1 Purpose .....	4
2.1.2 Applicability .....	4
2.2 Normative/informative references .....	4
2.2.1 Normative .....	4
2.2.2 Informative .....	5
2.3 Definitions .....	6
2.3.1 General .....	6
2.3.2 Disclosure classification .....	6
2.4 Abbreviations .....	6
2.5 Roles and responsibilities .....	7
2.6 Process for monitoring .....	7
2.7 Related/supporting documents .....	7
3. Requirements .....	8
3.1 General .....	8
3.1.1 Environmental conditions .....	8
3.1.2 Cooling requirements .....	8
3.2 Operational requirements .....	8
3.2.1 General .....	8
3.2.2 Yard AC Distribution Board .....	9
3.2.3 Outdoor Plug JB .....	14
3.2.4 Wall Mounted AC/DC Distribution Boards .....	14
3.2.5 19" AC/DC Distribution Boards .....	14
3.3 Electrical requirements .....	15
3.3.1 AC supply voltage .....	15
3.3.2 DC supply voltage .....	15
3.3.3 Lightning and surge protection .....	15
3.3.4 Miniature circuit breakers and isolating switches .....	16
3.3.5 Contactors .....	16
3.3.6 Earth leakage protection .....	16
3.3.7 Plug socket outlets .....	16
3.3.8 Termination and wiring .....	16
3.3.9 Earthing and bonding .....	19
3.3.10 DC voltage drop .....	19
3.4 Mechanical construction and layout .....	19
3.4.1 General .....	19
3.4.2 Yard AC Distribution Board .....	20
3.4.3 Outdoor Plug JB .....	20
3.4.4 Wall mounted AC/DC Distribution Boards .....	21
3.4.5 19" Distribution Modules .....	21
3.4.6 Cable gland plates .....	22
3.4.7 Corrosion protection and paint .....	22
3.4.8 Component layout .....	22

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3.4.9	Wire sizing.....	23
3.4.10	Labels and nameplates.....	23
4.	List of items required on contract .....	24
5.	Testing and quality assurance.....	26
5.1	General.....	26
5.2	Type testing.....	26
5.3	Routine testing .....	27
5.4	Operational tests .....	27
5.5	Continuity tests.....	27
5.6	Test certificates .....	27
5.7	Clearance for despatch .....	28
6.	Transport, labelling and packaging .....	28
6.1	Transport.....	28
6.2	Labelling.....	28
6.3	Packaging.....	28
7.	Drawings.....	29
8.	Authorization.....	29
9.	Revisions .....	30
10.	Development team .....	30
	Annex A – Technical Schedules A and B.....	31

**Tables**

Table 1:	Different configurations for Yard AC Distribution Boards .....	13
Table 2:	Transport costs .....	28
Table 3:	Drawings.....	29

## **1. Introduction**

This document specifies Eskom's requirements for indoor AC/DC Distribution Boards and outdoor AC Distribution Boards used in the Distribution Division.

## **2. Supporting clauses**

### **2.1 Scope**

This specification covers the minimum technical requirements for the design, testing at works, supply, delivery to site, off-loading, erection and commissioning of DC, AC and AC/DC distribution units for the Distribution Division's substations. The distribution units can be 19" modules or separate cubicles.

#### **2.1.1 Purpose**

This specification provides potential suppliers with a framework against which their offered products will be adjudicated. Further, this specification shall be the technical basis for any supply contract to be awarded.

The purchaser intends awarding a supply and packaging, contract (Eskom National Contract, ENC) for the manufacturing of Distribution Boards and Junction Boxes, for use at Eskom substations.

Subsequent to the award of the ENC, once manufacture of any of the DB's or JB's commences, further technical considerations that may arise will be negotiated between the supplier and the purchaser. Once agreement of these technical considerations by the purchaser and the supplier has been reached upon, the revised master drawing will be added to the ENC. Additionally, a revised set of Technical A/B schedules will be completed and submitted by the supplier.

#### **2.1.2 Applicability**

This document shall apply throughout Eskom Holdings Limited Divisions.

## **2.2 Normative/informative references**

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

### **2.2.1 Normative**

The following national, international and Eskom specifications and standards shall be read in conjunction with this specification. In cases of conflict, the order of preference shall be as follows: the South African Compulsory Specifications, SANS, the requirements of this specification and thereafter the International Standards. Parties using this document shall apply the most recent edition of the documents listed in this section.

- [1] IEC 60297-1:; Dimensions of mechanical structures of the 482,6mm (19 inch) series. — Part 1 Panels and racks, IEC, Latest
- [2] IEC 60898-1:; Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations Part 1: Circuit-breakers for AC operation., IEC, Latest
- [3] IEC 60898-2, Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations Part 2: Circuit-breakers for AC and DC operation, IEC, Latest
- [4] IEC 60947-6-1: Low-voltage switchgear and control gear - Multiple function equipment – Transfer switching equipment.
- [5] IEC 60947-3: Low-voltage switchgear and control gear – Switches, disconnectors, switch-disconnectors and fuse-combination units.
- [6] SANS 61643-1, Low voltage protective devices - Part1: Surge protective devices connected to low voltage power distribution systems – Requirements and tests, SANS, Latest

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- [7] SANS 164-0, Plug and socket-outlet systems for household and similar purposes for use in South Africa Part 0: General and safety requirements, SANS, Latest
- [8] SANS 164-1, Plug and socket-outlet systems for household and similar purposes for use in South Africa Part 1: Conventional system, 16A, 250V<sub>AC</sub>
- [9] SANS 767-1, Earth leakage protection units Part 1: Fixed earth leakage protection circuit-breakers., SANS, Latest
- [10] SANS 1091, National colour standard., SANS, Latest
- [11] SANS 10142-1, The wiring of premises Part 1: Low-voltage installations., SANS, Latest
- [12] SANS 60309-1, Plugs, socket-outlets and couplers for industrial purposes: Parts 1, 2 and 4, SANS, Latest
- [13] SANS 60529, Degrees of protection provided by enclosures (IP code)., SANS, Latest
- [14] SANS 60947-4-1, Low-voltage switchgear and controlgear. Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters., SANS, Latest
- [15] SANS 60947-1, Low-voltage switchgear and controlgear – Part 1: General rules, SANS, Latest
- [16] SANS 60947-2, Low-voltage switchgear and controlgear – Part 2: Circuit-breakers., SANS, Latest
- [17] SANS 60947-3, Low-voltage switchgear and controlgear. Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units., SANS, Latest
- [18] SANS 61643, Low-voltage surge protective devices, Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests., SANS, Latest
- [19] 240-64636794, Standard for wiring and cable markings in substations, Eskom, Latest
- [20] 240-70413291, Specification for Electrical Terminal Blocks, Eskom, Latest
- [21] 240-74997861, Distribution Specification for a Swing Frame Panel (19" rack) and blanking plates, Eskom, Latest
- [22] QM-58, Supplier Contract Quality Requirements Specification, Eskom, Latest
- [23] DSP\_34-1658, Corrosion protection specification for new indoor and outdoor distribution equipment, components, materials and structures manufactured from steel, Eskom, Latest
- [24] 240-70413291, Specification for Electrical Terminal Blocks, Eskom, Latest
- [25] DST\_34-462, Standard Design for Distribution Protection Schemes, Eskom, Latest
- [26] DST\_34-2151, Standard List for Protection Technician Tool and Test Equipment., Eskom, Latest
- [27] 240-88478369, Training Manual For The Operation And Maintenance Of Solar PV Plants, Eskom, Latest
- [28] 240-62629353, Specification for Panel Labelling Standard, Eskom, Latest

### **2.2.2 Informative**

- [29] 32-9, Definition of Eskom documents, Eskom Document Centre, Latest
- [30] 32-644, Eskom documentation management standard, Eskom Document Centre, Latest
- [31] 474-65, Operating manual of the Steering Committee of Technologies (SCOT), Vinod Singh, Latest
- [32] 240-60725641, Specification For Standard (19 Inch) Equipment Cabinets, Eskom, Latest

## 2.3 Definitions

### 2.3.1 General

Definition	Description
<b>1U</b>	A unit of vertical measurement as per IEC60297-1 equivalent to 44.45mm. Nineteen inch cabinet apertures, modules and blanking plates shall be specified as a multiple of 1U (e.g. 12U).
<b>Rated service short-circuit breaking capacity</b>	$I_{CS}$ is the maximum prospective fault current which the circuit breaker can clear and still remain serviceable.
<b>Rated ultimate short-circuit breaking capacity</b>	$I_{CU}$ is the maximum prospective fault current which the circuit breaker can clear.
<b>Residual Current Breaker with Overload protection</b>	An RCCB differs from an RCBO in that the RCBO will additionally respond to overcurrent conditions, whereas the RCCB will not respond to such conditions. However, add-on RCCBs are available from all manufacturers of MCBs and MCCBs. RCCBs are available for single-phase (two pole) and for three-phase (four-pole) applications.
<b>Residual Current Device</b>	A device designed to cause the opening of one or more contacts when the residual current flowing in the circuit protected by the RCD reaches the rated residual operating current of the device. A Earth Leakage Unit is a RCD.

### 2.3.2 Disclosure classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

## 2.4 Abbreviations

Abbreviation	Description
<b>AC</b>	Alternating Current
<b>ATS</b>	Automatic Transfer Switch
<b>ATSE</b>	Automatic Transfer Switching Equipment
<b>DB</b>	Distribution Board
<b>DC</b>	Direct Current
<b>ELU/EL</b>	Earth Leakage Unit
<b>FAT</b>	Factory Acceptance Test
$I_{CS}$	Rated service short-circuit breaking capacity
$I_{CU}$	Rated ultimate short-circuit breaking capacity
<b>JB</b>	Junction Box
<b>MCB</b>	Miniature Circuit Breaker
<b>RCBO</b>	Residual Current Breaker with Overload protection
<b>RCCB</b>	Residual Current Circuit-breaker
<b>RCD</b>	Residual Current Device

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Abbreviation	Description
SANS	South African National Standards
TBD	To be Determined
V	Volts
VT	Voltage Transformer

## 2.5 Roles and responsibilities

The supplier is to take cognisance of the following with regards to the tender returnables. An incomplete tender submission will be deemed as non-compliant.

- a) An alternative offer shall only be considered if the main offer is compliant.
- b) Specific schedule A: The Purchaser's Requirements.
- c) Specific schedule B: Guarantees Technical Particulars (to be completed by the supplier).

The supplier shall not change the content of this document.

The supplier shall state clearly, for each clause that requires a statement of compliance in the A/B schedules. The supplier must respond by either stating "Comply" or "Do not Comply" and state any deviations. If a clause in the A/B schedule requires a statement of compliance and additional information, the supplier shall state clearly "Comply" and shall provide detail information or state "Do not Comply" and shall provide detail information. If a clause in the A/B schedule requires information only, the supplier shall provide the necessary information.

Eskom and its vendors are subject to the Occupational Health and Safety Act with regulations (Act No.85 1993 of the Republic of South Africa), Project and Construction Management Professions Act, (Act No. 48 of 2000 of the Republic of South Africa) as well as, the Engineering Profession Act (Act No. 46 of 2000 of the Republic of South Africa). All the equipment shall meet the requirements of the Act or the legislative requirements applicable to the territory in which the equipment shall be located. All equipment shall comply with the fundamental safety requirements of Clause 5 of SANS 10142-1. Distribution boards shall as a minimum be designed constructed and tested in accordance with the requirements of Clause 6.6 of SANS 10142-1. The design of AC distribution boards must comply with SANS 10142-1. All components used within DB's must comply with the compulsory standards and SANS. Any conflict between this specification and statutory requirements shall be brought to the attention of the purchaser for written clarification.

## 2.6 Process for monitoring

The equipment will be routine tested and inspected prior to requesting inspection by the purchaser's quality control group. The purchaser shall be advised not later than seven days before the due date for inspection and testing. Unless specified to the contrary, type testing shall consist of performing the tests on at least one sample of the design.

Tests shall be performed on equipment, which has not been the subject of previous type testing or at the purchaser's discretion on equipment which has been the subject of any modification, which could affect the performance of the equipment. A prototype inspection shall be performed to ensure that the equipment is of sound construction and, so far as can be ascertained, meets the requirement of this specification.

Routine testing and the final visual inspection shall be performed by the supplier prior to dispatch to sites.

## 2.7 Related/supporting documents

This document supersedes document 34-1301 "Distribution Group's specific requirements for AC/DC Distribution Boards" that was published in March 2009.

### 3. Requirements

#### 3.1 General

##### 3.1.1 Environmental conditions

###### 3.1.1.1 The equipment covered by this specification shall be suitable for operation under the following conditions:

- i. altitude : 2 200 m maximum
- ii. relative humidity : 10 % to 85 % (non-condensing)
- iii. lightning : high lightning area

###### 3.1.1.2 Outdoor air temperatures:

- i. maximum : 50°C
- ii. daily average : 30°C
- iii. yearly average : 20°C
- iv. minimum : -10°C

###### 3.1.1.3 Equipment room air temperatures:

- i. maximum : 50°C
- ii. yearly average : 25°C
- iii. minimum : -5°C

#### 3.1.2 Cooling requirements

The equipment shall be cooled by natural air convection only, unless otherwise specified or approved. Louvers shall be provided on the sides of the Yard AC Distribution Board and Wall Mounted Distribution Boards. The louvers shall have insect proof gauze and a splash plate.

### 3.2 Operational requirements

#### 3.2.1 General

The distribution of auxiliary power within the substation is achieved by using outdoor and indoor Distribution Boards. The AC power is supplied from an auxiliary transformer (typically 100 kVA) or a suitable power voltage transformer (VT). The auxiliary transformer is fitted with 3-phase, 50A and 100A MCBs which respectively supply AC power to the main transformer cooling fans and the balance of the AC loads within the substation. The AC power supplied from the auxiliary transformer or VT can be fed either via a Yard AC Distribution Board or directly to the Distribution Boards in the equipment room. The Yard AC Distribution Board is an intermediate board which splits the power distribution between the yard loads (outdoors) and the equipment room loads (indoors).

Depending on the application and size of the substation, the DC power is supplied from battery chargers rated at nominal DC output voltages of 24V, 32V, 48V, 110V and a maximum of 220V.

All selected equipment shall be rated for the following typical loads at site:

- Tap-change and gate motors
- Lights – LED, Incandescent and Florescent
- Power-electronic equipment
- Heaters

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### **3.2.2 Yard AC Distribution Board**

The main purpose of the Yard AC Distribution Board is to provide an AC supply change-over facility where more than one AC supply source is available and to provide for the distribution of AC power to load equipment in the substation HV Yard (normally outdoors).

The Yard AC Distribution Board is based on a modular design and consists of the enclosure which houses the following modules:

- control modules - responsible for the monitoring of the incoming AC supplies and controlling the flow of AC power to the load equipment,
- a distribution module - consisting of the AC MCBs and handles the distribution and protection of load circuits,
- the termination module – consisting of various input and output power circuit terminals and
- the plug box - housing the 1-phase and 3-phase plug socket outlets.

Drawing set, D-DT-11200, sheets 1 – 4, details the layout, design and electrical connections for the Yard AC Distribution Board.

#### **3.2.2.1 Control modules**

The control module consists of a control circuit and a power circuit.

i. Control circuits:

- The control circuit monitors and controls the flow of power through the power circuits.
- When two control modules are selected, two indication lamps and one preferred supply switch shall be fitted onto the front cover. The interconnection of the two control modules shall make up the change-over module.
- Electrical and mechanical interlocking shall be provided to prevent the possibility of paralleling the incoming supplies when more than one auxiliary supply is available and alive.
- An AC phase failure and phase sequence relay with indication shall be used to monitor the quality of each incoming supply.
- A delay-on-pickup timer shall be provided to delay the energising of the incoming contactor by 5 - 10s to prevent the contactor from operating too frequently during an HV fault condition. The timer shall be settable between 0 – 60s.
- AC phase fail potential-free remote alarm contacts shall be supplied for each incoming supply.
- This equipment shall also conform to the AC Supply Voltage as per section 3.3.1 of this document.
- The change-over circuit shall operate as follows:

When both supplies are healthy and supply 1 is selected as the preferred supply, contactor 1 shall be energised after the set delay. When supply 1 is lost the change-over circuit shall automatically change over to the alternative healthy supply 2. If supply 1 becomes healthy again, then the change-over circuit shall change back to supply 1 (preferred supply). When supply 2 is selected as the preferred supply, the opposite operation shall occur.

ii. Power circuits:

- The incoming AC supplies are fed via the termination module input terminals (R1 – N2) to the 100A, 5kA, 4-pole breaker isolators from where it goes to the input terminals of the contactors.

- On the output side of the contactors, the output circuit is jumpered and fed to the 3-phase busbars of the distribution module from where it is distributed to the different load circuits.
- The contactors shall be rated for continuous operation.

#### 3.2.2.2 Distribution module

- i. The distribution module consists of AC MCBs which supply and protect the different load circuits.
- ii. The MCBs shall be rated to protect the connected load cables.
- iii. The incoming AC supply to the MCBs shall be provided via a suitably rated three phase busbar system.
- iv. A three-phase contactor shall be provided to power the floodlights circuits.

#### 3.2.2.3 Termination module

- i. The termination module consists of suitably rated terminals for the connection of the incoming AC supply circuits (when applicable) and the different load circuits. All terminals shall comply with the requirements of 240-70413291, Specification for Electrical terminal blocks

#### 3.2.2.4 Incoming Supply Selector switch

- i. This switch shall be used to select a preferred supply. This switch shall be mounted on the front cover plate. In the case of a single incoming AC supply, a selection switch is not required, but the mounting hole for the switch shall be made and plugged with a grommet. This item is applicable to the Yard AC Distribution board.
- ii. The incoming supply selector switch shall also be used to switch pilot lamps used to indicate which supply is selected.

#### 3.2.2.5 Indication lamps

Indication lamps shall be mounted on the front cover plate to indicate the status of the incoming supplies. In the case of a single incoming AC supply, only one indication lamp is required, but the mounting hole for the other indication lamp shall be made and plugged with a grommet.

#### 3.2.2.6 Plug box

- i. A plug box shall be provided on the left-hand side (front view) of the cabinet.
- ii. The plug box shall house a 3-phase, 16A round, 5 pin test socket and a 1-phase, 16A, 3 pin, switched socket outlet. The 1-phase 16A, 3 pin socket outlet will be powered via a 2-pole, 30 mA earth leakage unit and a dedicated 16A MCB for the socket outlet. The 3-phase 16A round 5 pin test socket shall be powered by a dedicated 16A MCB. This is because of problems that have been experienced with test equipment that trip the 3-phase leakage unit.
- iii. The 3-phase, 16A, round, 5 pin test socket shall have an interlock to ensure that the plug can neither be withdrawn from the socket-outlet or connector while the contacts are alive, nor be inserted while the switching device is in the "ON" position. Socket-outlets that do not conform to this requirement shall be subjected to a test for breaking capacity and normal operation, according to SANS 60309-1, *Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements*.

#### 3.2.2.7 Automatic Changeover Switching Equipment

An alternative to using the incoming supply selector switch, indication lamp and control module would be a 125A Automatic Transfer Switching Equipment (ATSE). This ATSE shall comply with the following requirements:

- Rated operational voltage and current capacity, number of poles (fully rated) and characteristics according to IEC 60947-6-1 and IEC 60947-3.
- The ATSE supplied shall be designed and built as a fully integrated, maintenance free product (power switching, motorisation and ATS Control), shall be of the same recognized manufacturer and shall be tested to IEC 60947-6-1 as one complete unit.
- An open transition break before make architecture (I – 0 – II), in full compliance with IEC 60947-6-1 Class PC.

i. GENERAL CONSTRUCTION

- The ATSE shall be composed of :
  - a) Two side-by-side, fully rated, IEC 60947-3 compliant, load break switch disconnects.
  - b) A maintenance free switch design that includes self-cleaning contacts on all poles.
  - c) An inherent fully integrated robust mechanical interlock between both switches.
  - d) An independent switching mechanism free from external factors during transfer.
  - e) A wide band control voltage with the electronic control fitted directly to the switching mechanism.
  - f) An integrated ATS controller with dual power supply (DPS) and 3 phase sensing on both source supplies.
  - g) Emergency manual operation.
  - h) Padlocking in I, II or zero position (configurable) with the use of up to 8mm padlock.
  - i) Clear positive indication on the switch position (I – 0 – II).
- The ATSE shall be fully integrated in one device which means that besides customer I/O, no additional wiring between functional units other than the power connections shall be necessary to allow the proper functioning of the ATSE.
- The ATSE shall include an "Equipment Ready Output". A self-test feature shall be available which analyse / test the equipment condition periodically and communicate through dry contacts to report the ability of the transfer switching equipment to operate.

ii. RATINGS AND ATSE TEST

- Characteristics, nominal phase voltage, current ratings, number of poles and withstand ratings shall be as shown on the drawings. The ampere ratings shall be for 100% continuous load current with the neutral pole fully rated.
- Ratings and characteristics shall be according to IEC 60947-6-1 and IEC 60947-3 with non-welding of contacts during the performance of withstand and closing tests.
- The complete ATSE shall be fully factory assembled by the manufacturer and tested to IEC 60947-6-1 so as to ensure proper operation of the ATSE as a complete system with a good overall operation sequence. The test must also ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

iii. DESIGN REQUIREMENTS:

- The ATSE shall be class PC according to IEC 60947-6-1 with 3 stables positions: I – 0 - II.
- Besides the ATSE features as per IEC 60947-6-1, the equipment shall be a Load Break and Disconnect switch as per IEC 60947-3 with padlocking.
- The ATSE shall be of the clearly positive position indication type with markings I - 0 - II

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- The ATSE shall be electrically operated and fully automatic with the possibility to inhibit the automation via dry contact order.
- Emergency manual operation shall be provided using a handle.
- The ATSE shall be self-powered.
- The ATSE shall have a distinct manual / automatic mode selectable by opening a cover.
- The neutral pole of the ATSE switches shall be fully rated and configurable for left or right connection.
- The ATSE shall have no power consumption while in a stable position other than that required for the ATS control unit.
- The 4 poles shall switch simultaneously to avoid potential floating neutral issues during switching.

iv. SAFETY REQUIREMENTS & FEATURES:

- Under no circumstance (including equipment failure) should it be possible to close switch I and switch II simultaneously.
- During manual operation, opening and closing of the contacts must be independent from the emergency handle operating speed.
- The ATSE shall have a built-in provision for padlocking in the 0 position. One 4mm padlock should be sufficient to padlock whilst it should be possible to use up to a 8mm padlock.
- All operating modes shall be inhibited when the product is padlocked.
- Padlocking shall only be possible with the switch in manual position.
- An emergency handle shall be provided for manual operation.
- The ATSE should allow manual switching I-0-II at full load without damage to the contacts.

v. BASIC OPERATION:

- The ATSE should have distinct Auto and Manual operational modes that should be fully operational under any load condition. (Within the product ratings intended scope).
- The ATSE shall have the facility to inhibit the ATS controller through an input.
- The ATSE transfer time shall be between 50 ms to 2000 ms.

vi. ATS CONTROLS

- The ATSE shall have a fully integrated ATS Controller.
- The controller shall include LED's and configuration potentiometers with front access.
- Main Parameters:
  - a) The ATS controller shall include 3 phase and neutral sensing for both source supplies.
  - b) Voltage settings shall be field adjustable.
  - c) Frequency settings shall be adjustable.
  - d) The ATS Controller shall have the possibility to select the network type between three-phase and single-phase via front access potentiometers.

vii. ATSE INTERFACE:

- Status of the ATSE shall be clearly visible through LED's on the front of the unit.
- Selected source indication shall be available via potential free contacts.

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viii. **TIMER SETTINGS:**

- A timer of 0 to 60 seconds shall be provided to detect source 1 or source 2 failures, and to override any transient outages of the normal supply. (Failure Timer, FT).
- A possibility to stay 2s in switch position 0 shall be provided (0 Timer, OT).
- An adjustable timer of 0 to 1800 seconds shall be provided to detect priority network return to normal so as to override any incorrect availability of the normal supply. (Main Return Timer, RT).

ix. **INSTALLATION**

Installation and wiring shall be in accordance with manufacturer's instructions and recommendations.

**3.2.2.8 Yard AC Distribution Board configurations**

Table 1 shows the different ways in which this board can be configured to cater for single, dual and more auxiliary transformers at a substation.

**Table 1: Different configurations for Yard AC Distribution Boards**

Items	Single control yard AC distribution board (with distribution and termination modules) 0185221	Dual control yard AC distribution board (with distribution and termination modules) 0185222	Dual control yard AC distribution board (without distribution and termination modules) 0185223
Control module 1	X <sup>1</sup>	X	X
Control module 2	---	X	X
Supply 1 Indication lamp	X	X	X
Supply 2 Indication lamp	Blanked off	X	X
Supply selector switch	X <sup>1</sup>	X	X
Distribution module	X	X	---
Terminal module	X	X	X
Supply 1 terminals (R1 – N1)	X	X	X
Supply 2 terminals (R2 – N2)	X	X	X
Relay house terminals (1 – 4)	X	X	---
Neutrals (11, 18, 25, 32)	X	X	---
Other load terminals	X	X	---
Additional set of Supply terminals	---	---	X <sup>2</sup>
Label schedule	X	X	X
Automatic Change over		X <sup>3</sup>	X <sup>3</sup>

**NOTE 1:** Supply selector switch in supply 1 position. Jumper between ACFT(11) and COC-1(A1).

**NOTE 2:** This set of terminals is the same type as R1 – N1 and will be used for the secure supply at the paralleled outputs of the contactors, on the control modules.

**NOTE 3:** This switch replaces the Control Modules, Supply Indication lamps and the supply selector switch.

### **3.2.3 Outdoor Plug JB**

The main purpose of the Outdoor Plug JB is to provide plug points for testing purposes in substation yards. This would typically be where the yard is large and the Yard AC DB is more than 30m from the equipment that would need to be tested. The intention is to reduce the risk of running long power leads to test Primary Plant equipment.

There are two types of the Outdoor Plug JB's. One is with a 2-pole, 30 mA earth leakage unit and one is without the 2-pole, 30mA earth leakage unit. The one with the ELU shall be supplied from any one of the 3 pole MCBs in the Yard AC DB. The one without the ELU shall be supplied from the Yard AC DB's 2-pole, 30mA earth leakage unit. This is to reduce the cost of the JB.

The Outdoor Plug JB consists of:

- Terminals – For terminating the incoming and outgoing loop cables.
- 3-pole 20A MCB – To act as in switching point for the plug points
- 2-pole, 30mA earth leakage unit – optional as discussed above
- 3-phase, 16A, round 5 pin test socket - the test socket shall have an interlock to ensure that the plug can neither be withdrawn from the socket-outlet or connector while the contacts are alive, nor be inserted while the switching device is in the "ON" position. Socket-outlets that do not conform to this requirement shall be subjected to a test for breaking capacity and normal operation, according to SANS 60309-1:2006, *Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements*
- A double 1-phase, 16A, 3 pin, switched socket outlet – Mounted in a standard 4 x 4 plug box.
- 3-Pole, 32A Isolator/MCB – To act as a switching point for the next Outdoor Plug JB to be connected.

### **3.2.4 Wall Mounted AC/DC Distribution Boards**

The wall mounted distribution boards are located inside the equipment room and their main purpose is the distribution of AC and DC power to all loads within the equipment room and sometimes even some outdoor loads.

Two types of wall mounted AC/DC Distributions Boards are available viz. a 24/24 way and a 36/36 way distribution board. The numbers refer to the number of AC and DC MCB poles available on each board. The boards are mechanically split into an AC Distribution Board on the left hand side and a DC Distribution board on the right hand side. The AC Distribution Board has 1-pole and 3-pole AC MCBs and a 4-pole incoming isolator. The DC Distribution Board has 2-pole DC MCBs and 2-pole incoming isolators.

The 24/24 way and 36/36 way distribution boards are detailed in drawing sets D-DT-11220 (sheets 1 – 3) and D-DT-11221 (sheets 1 – 3) respectively.

A plug box is provided at the bottom of the distribution board which houses a three 16 A, 3 pin, switched socket outlets. All socket outlets shall be powered via a 2-pole, 30mA earth leakage unit and a dedicated 16A MCB for the 1-phase socket outlets.

### **3.2.5 19" AC/DC Distribution Boards**

The 19" AC/DC Distribution Board is a free standing panel populated with AC and DC Distribution Modules which are located inside the equipment room and their main purpose is the distribution of AC and DC power to all loads within the equipment room and sometimes even some outdoor loads. This distribution board (19" panel) is also used to house the switched mode rectifiers.

Three types of 19 inch AC/DC configurations are available depending on the number of load circuits viz. 14/10 way, 14/20 way and 28/20 way.

The available drawing sets are indicated in Annex B.

**3.2.5.1** The main module – consists of an AC failure indication and alarm relay and a voltmeter with selector switch. The voltmeter is used to display phase-neutral and phase-phase voltages.

**3.2.5.2** The single-phase AC distribution module – consists of 1-pole AC load MCBs.

**3.2.5.3** The three-phase AC distribution module – consists of 3-phase AC load MCBs.

**3.2.5.4** AC supply module with 3 phase plug – consists of a 16A, round, 5 pin test socket and two 16A, 3 pin, switched socket outlets. The 1-phase 16A, 3 pin socket outlets will be powered via a 2-pole, 30 mA earth leakage unit and a dedicated 16A MCB for the socket outlet. The 3-phase, 16A round 5 pin test socket shall be powered by a dedicated 16A MCB. The 3-phase, 16A, round, 5 pin test socket shall have an interlock to ensure that the plug can neither be withdrawn from the socket-outlet or connector while the contacts are alive, nor be inserted while the switching device is in the "ON" position. Socket-outlets that do not conform to this requirement shall be subjected to a test for breaking capacity and normal operation, according to SANS 60309-1:2006, Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements.

**3.2.5.5** AC supply module without 3 phase plug – consists of four 16A, 3 pin, switched socket outlets. All socket outlets shall be powered via a 2-pole, 30mA earth leakage unit and a dedicated 16A MCB for the 1-phase socket outlets.

**3.2.5.6** AC supply change over module – consists of a 3-phase and neutral incoming isolator, incoming AC change over contactors and indication lamps to indicate healthy incoming supplies. An alternative would be an automatic change over switch such as an ABB –, Socomec – or equivalent Automatic Change over Switch.

**3.2.5.7** The DC distribution module – consists of 2-pole load MCBs.

**3.2.5.8** The DC interface module – consists of a 2-pole DC MCB for the battery, a standby battery charger input socket and two 4-pole isolators to facilitate manual changeover from normal to standby DC power.

**3.2.5.9** The main AC incoming module – consists of a 3-phase and neutral incoming isolator, an incoming contactor, a phase-fail and timer relay and indication lamps to indicate a healthy incoming supply.

**3.2.5.10** The single-phase Incoming AC supply module – consists of 3-phase surge protection, module isolator and 10 x 1-phase AC load MCBs.

### **3.3 Electrical requirements**

#### **3.3.1 AC supply voltage**

A.C. supplies shall be 230V phase-to-neutral and 400V phase-to-phase. The frequency shall be 50Hz nominal, variable between 47Hz and 51Hz. Total harmonic distortion, including all harmonics up to the order of 40, shall not exceed 8%. There can be a variation in the auxiliary supply voltages within  $\pm 15\%$  of nominal. This is in line with Metering standards.

#### **3.3.2 DC supply voltage**

The 110V and 220V DC systems are not earthed (floating). The 48V DC systems are to be positively earthed.

#### **3.3.3 Lightning and surge protection**

The AC input circuitry shall be protected against lightning induced voltage surges. Surge arresters shall comply with the requirements of SANS 61643, Low-voltage surge protective devices, Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests. Surge arresters shall be provided on the incoming AC side of the Yard AC Distribution Board, the Main AC Incoming Module (19") and the 19" change-over module. In situations where none of the above modules or Yard AC Distribution Board is used, a 1-phase incoming AC supply module will be installed.

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### **3.3.4 Miniature circuit breakers and isolating switches**

**3.3.4.1** The incoming supply (cable) to the DC distribution board shall be protected by an MCB on the supply side (battery charger) with a 2-pole isolating switch on the DC distribution board.

**3.3.4.2** All DC isolators and load MCBs shall be 2-pole, rated at a minimum short-circuit capacity of 5kA and a minimum operating voltage of 140VDC across the poles continuously for the 110VDC Distribution module.

**3.3.4.3** The 220VDC Distribution module MCB and Isolators shall be 2-pole, rated at a minimum short-circuit capacity of 5kA and a minimum operating voltage of 280VDC across the poles continuously.

**3.3.4.4** All MCBs shall comply with the requirements of SANS 60947-2: Low-voltage switchgear and controlgear – Part 2: Circuit-breakers and IEC 60898, Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations (Parts 1 and/or 2 as appropriate).

**3.3.4.5** The following requirements are of particular importance:

- i. Breaking capacities shall be in accordance with IEC 60989 and SANS 60947-2;
- ii. AC Supply MCBs rated service short-circuit breaking capacity ( $I_{CS}$ ): 5kA at least;
- iii. DC Supply MCBs rated service short-circuit breaking capacity ( $I_{CS}$ ): 5kA at least with a time constant of at least 4ms;
- iv. Utilisation/Selectivity category A (SANS 60947-2).
- v. Maximum service voltage at least  $V_{Nominal} + 20\%$ .
- vi. Pollution degree 3 or higher (SANS 60947-2 & SANS 60947-1 section 6.1.3.2).
- vii. Suitable for isolation (SANS 60947-2).
- viii. Curve C (SANS 60947-2 and IEC 60898).

**3.3.4.6** All MCBs shall be wired with the source supply at the top, and the load supply at the bottom (SANS 10142-1). Where MCBs are polarity sensitive, the manufacturer shall provide a diagram indicating the correct wiring with the source supply at the top.

### **3.3.5 Contactors**

All contactors shall comply with the requirements of SANS 60947-4-1, Low-voltage switchgear and control-gear Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters.

### **3.3.6 Earth leakage protection**

All earth leakage units shall comply with the requirements of SANS 767-1, Earth leakage protection units – Part 1: Fixed earth leakage protection circuit-breakers. They shall also to be Residual Current Breaker with Overload protection devices. These are described in 240-88478369: Training Manual for the Operation and Maintenance of Solar PV Plants, section 4.4.

### **3.3.7 Plug socket outlets**

**3.3.7.1** The 1-phase socket outlets shall comply with the requirements of SANS 164, Plug and socket-outlet systems for household and similar purposes for use in South Africa, Parts 0 and 1.

**3.3.7.2** The 3-phase socket outlets shall comply with the requirements of SANS 60309-1, Plugs, socket-outlets and couplers for industrial purposes: Parts 1, 2 and 4.

### **3.3.8 Termination and wiring**

**3.3.8.1** All wiring shall comply with 240-64636794, Standard for Wiring and Cable Marking in Substations.

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**3.3.8.2** All wiring shall be numbered.

**3.3.8.3** All AC wiring shall be colour coded as follows:

- i. Red phase (RØ) – red insulation
- ii. White phase (WØ) – white insulation
- iii. Blue phase (BØ) – blue insulation
- iv. Neutral phase (NØ) – black insulation
- v. Earthing (E) – green and yellow insulation

**3.3.8.4** All DC wiring shall be colour coded as follows:

- i. Positive polarity (+) – red insulation or grey panel wire with red heat shrink on both ends
- ii. Negative polarity (-) – blue insulation or grey panel wire with blue heat shrink on both ends

**3.3.8.5** Where possible, wiring shall be placed in trunking to keep the wiring neat. All terminals and components shall be labelled as indicated on the drawings.

**3.3.8.6** All wire ends shall be suitably lugged and crimped with the tools as specified in DST\_34-2151, Standard List for Protection Technician Tool and Test Equipment. Currently it is JST type YNT range or Cembre type HP4.

**3.3.8.7** All terminals shall comply with the requirements of 240-70413291, Specification for Electrical Terminal Blocks.

**3.3.8.8** All Lugs shall comply with the requirements of section 3.2.8 of 240-70413291, Specification for Electrical Terminal Blocks. It should be hook blade, pre-insulated lugs with a maximum of two per terminal.

**3.3.8.9** Terminals for remote alarms shall be provided for connection of external cabling to remote alarm termination points. The type of terminal shall be Klippon RSF1 or equivalent.

**3.3.8.10** The terminations and wiring for the Yard AC Distribution Board and Outdoor Plug JB shall be as follows

- i. The control module and distribution module key diagrams are respectively detailed in D-DT-11200, sheets 2 and 3.
- ii. The terminals used shall be Weidmuller (spring loaded terminals), the GEC Entrelec terminals or equivalent suitable for the wire sizes used. The latter is the preferred terminal. The associated terminal end caps and spacers shall be used.
- iii. The input power wiring shall be 25mm<sup>2</sup> stranded copper wire, insulated with 1000Vac insulation. The AC input terminals shall be of the bolt-on type suitable for the wire size, supplied with the necessary accessories e.g. inter-terminal sheds.
- iv. All control wiring shall be 2.5mm<sup>2</sup> stranded copper wire, insulated with 1000 V<sub>AC</sub> insulation.
- v. The wiring between MCB-3 and terminals 1 – 3 shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000 V<sub>AC</sub> insulation.
- vi. All other load wiring between the MCBs and terminals shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.

**3.3.8.11** The terminations and wiring for the Wall Mounted AC/DC Distribution Boards shall be as follows:

- i. No terminals will be used in these distribution boards. All terminations will be done directly onto the MCB terminals.
- ii. All power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.

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- iii. Three phase Merlin Gerin (or equivalent) busbars shall be used for connection between the AC MCBs and 2-phase Merlin Gerin (or equivalent) busbars shall be used for connection between the DC MCBs.
  - iv. The power wiring between the MCBs and plug outlets shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.

**3.3.8.12** The terminations and wiring for the 19" AC/DC Distribution Board modules shall be as follows:

- i. A wire loom shall be used to connect the components on the face plate with the terminals on the back plate. The loom shall be made of flexible multi-strand copper wire and shall have a length of between 1.1m to 1.2m from where it exits the face plate to where it enters the back plate. The loom sock shall be continuous (without joints) and have some slack to maintain flexibility. The loom shall exit the face plate at the left hand side (viewed from the front of the panel) and also enter the back plate on the left hand side.
- ii. The terminals used shall be Weidmuller (spring loaded terminals), the GEC Entrelec terminals or equivalent suitable for the wire sizes used. The latter is the preferred terminal. The associated terminal end caps and spacers shall be used.
- iii. The Main module - All power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. All control wiring shall be 2.5mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.
- iv. The single-phase AC distribution module - The input power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. The output power (between the MCB outputs and the terminals) wiring shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. 3-phase Merlin Gerin (or equivalent) busbars shall be used for connection between the AC MCBs. An appropriately rated neutral bar can be inserted if required for wiring purposes.
- v. The three-phase AC distribution module - The input power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. The output power (between the MCB outputs and the terminals) wiring shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. 3-phase Merlin Gerin (or equivalent) busbars shall be used for connection between the AC MCBs. An appropriately rated neutral bar can be inserted if required for wiring purposes.
- vi. AC supply module - All wiring shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.
- vii. AC supply change over module - All power wiring shall be 25mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. All control wiring shall be 2.5mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.
- viii. The DC distribution module - The input power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. The output power (between the MCB outputs and the terminals) wiring shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. 2-phase Merlin Gerin (or equivalent) busbars shall be used for connection between the DC MCBs.
- ix. The DC interface module - All power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.
- x. The Main AC incoming module - All power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. All control wiring shall be 2.5mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation.
- xi. The single-phase Incoming AC supply module - The input power wiring shall be 16mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. The output power (between the MCB outputs and the terminals) wiring shall be 4mm<sup>2</sup> stranded copper wire, insulated with 1000V<sub>AC</sub> insulation. 3-phase Merlin Gerin (or equivalent) busbars shall be used for connection between the AC MCBs. An appropriately rated neutral bar can be inserted if required for wiring purposes.

### **3.3.9 Earthing and bonding**

**3.3.9.1** As specified in DST\_34-462, Standard Design for Distribution Protection Schemes; section 4.8.6.

**3.3.9.2** The cabinet doors shall be bonded to the brass earth stud with green and yellow insulated 1000 VAC, 2.5mm<sup>2</sup> multi-strand copper wire.

**3.3.9.3** The earth wire shall be long enough to allow the doors to fully open.

**3.3.9.4** All gland plates shall also be earthed to the earth stud. The contact resistance between the brass stud and any part of the gland plate and door shall be less than 0.1Ω.

**3.3.9.5** The gland plate shall be earthed to the brass earthing stud by means of a braided tinned copper earthing strap with an effective copper cross-sectional area of 12mm<sup>2</sup>.

**3.3.9.6** All modules shall also be earthed to the earth stud and a contact resistance of less than 0.1Ω shall be ensured.

### **3.3.10 DC voltage drop**

The voltage drop between the DC input terminals and the load output terminals shall be less than 500mV, tested at the supply MCB rated current. The correct design must be proven during Type testing of the prototype and must be proven on every unit during Routine Testing. FAT shall be done at full rated current for that portion of the circuit.

## **3.4 Mechanical construction and layout**

### **3.4.1 General**

**3.4.1.1** The equipment shall be housed in self-supporting cabinets, where applicable, fitted with metal panels and doors and reinforced where necessary to ensure rigidity.

**3.4.1.2** The doors shall be fitted with a quality gasket, which means that the sealing material shall always return to its original profile after compression. The material shall not deteriorate over time (typically 15 years).

**3.4.1.3** The cabinet doors shall be fitted with pad lockable lever handles.

**3.4.1.4** The various circuit components required for the distribution units and their proposed circuit positions shall be as shown on the applicable drawings (see annex B). Drawings with proposed layouts and dimensions shall be submitted with each tender.

**3.4.1.5** The equipment sizes shall conform to the maximum dimensions specified in drawings.

**3.4.1.6** All holes through which wiring must pass shall have their edges protected using grommets.

**3.4.1.7** Self-tapping screws used in the construction shall have blunt points. Self-tapping screws shall not be used for fixing items that have to be removed and replaced. Pop rivets may be used for fixing of non-removable components.

**3.4.1.8** All MCBs and equipment required to have operation access shall be accessible through a front opening door that can be padlocked. All other components in the enclosure shall be covered by a removable cover plate. Rear or side access is not acceptable, as installation against walls and in very small rooms will be necessary.

**3.4.1.9** The final equipment design shall be submitted to Eskom for approval before the prototype is built.

### **3.4.2 Yard AC Distribution Board**

**3.4.2.1** The Yard AC distribution board shall be an outdoor weatherproof enclosure, made from 1.6mm 3CR12 stainless steel or material with equivalent or better performance characteristics. They must be able to be mounted on the auxiliary transformer structure, CT/VT structure or a dedicated Yard AC DB mounting structure as in D-DT526 Sheet 1A and 2A.

**3.4.2.2** All other parts and fixtures exposed to the environment shall be made from 3CR12 stainless steel or brass.

**3.4.2.3** All welds shall be waterproof. The welds shall be completed using a MIG welder and 3CR12 or stainless steel wire.

**3.4.2.4** The board shall be protected from water and dust ingress to IP 53.

**3.4.2.5** The back plates and stand-off brackets shall be manufactured from 1.6mm 3CR12 stainless steel or material with equivalent or better performance characteristics.

**3.4.2.6** The inner door shall be locked with two square keys mounted in the right-hand side top and bottom corners.

**3.4.2.7** A warning label indicating electrical shock hazard shall be fitted on the outside door.

**3.4.2.8** A 60mm, M16 earth stud, with 4 washers and two nuts, made from brass shall be fitted as indicated on the drawings. Brass quality specification 303 shall apply. The stud must protrude outside of the box for substation earth strap connection.

**3.4.2.9** All MCBs shall not protrude more than 3mm through the cut-outs.

**3.4.2.10** A suitable pocket shall be provided on the inside of the door for the load distribution schedule.

**3.4.2.11** A copper neutral bar with dimensions, 25mm x 270mm x 6mm shall be mounted in an easily accessible location at the back of the enclosure.

**3.4.2.12** All screws, bolts, washers and nuts shall be made of stainless steel.

**3.4.2.13** Washing lines made from 10mm round bar shall be fitted below the MCB terminals for ease of termination.

### **3.4.3 Outdoor Plug JB**

**3.4.3.1** The Outdoor Plug JB shall be an outdoor weatherproof enclosure, made from 1.6mm 3CR12 stainless steel or material with equivalent or better performance characteristics. This is for mounting to Primary Pant equipment structure.

**3.4.3.2** All other parts and fixtures exposed to the environment shall be made from 3CR12 stainless steel or brass.

**3.4.3.3** All welds shall be waterproof. The welds shall be completed using a MIG welder and 3CR12 or stainless steel wire.

**3.4.3.4** The JB shall be protected from water and dust ingress to IP 53.

**3.4.3.5** The back plates and stand-off brackets shall be manufactured from 1.6mm 3CR12 stainless steel or material with equivalent or better performance characteristics.

**3.4.3.6** A warning label indicating electrical shock hazard shall be fitted on the outside door.

**3.4.3.7** A 60mm, M16 earth stud, with 4 washers and two nuts, made from brass shall be fitted as indicated on the drawings. Brass quality specification 303 shall apply. The stud must protrude outside of the box for substation earth strap connection.

**3.4.3.8** All screws, bolts, washers and nuts shall be made of stainless steel.

#### **3.4.4 Wall mounted AC/DC Distribution Boards**

**3.4.4.1** The Wall mounted AC/DC distribution board shall be an enclosure made from 1.6mm electro-galvanised mild steel and mounted on the equipment room wall. The board shall be protected from water and dust ingress to IP 45.

**3.4.4.2** 100mm x 100mm x 3mm galvanised steel plates shall be fitted on each corner at the back of the enclosure to provide re-enforcement at the mounting holes. The mounting holes' size shall be M13.

**3.4.4.3** The stand-off brackets shall be manufactured from 1.6mm mild steel.

**3.4.4.4** The inner door shall be locked with a square key.

**3.4.4.5** A warning label indicating electrical shock hazard shall be fitted on the outside doors.

**3.4.4.6** Two 50mm, M10 earth studs with locknuts made from brass shall be fitted as indicated. Brass quality specification 303 shall apply.

**3.4.4.7** All MCBs shall not protrude more than 3mm through the cut-outs.

**3.4.4.8** A suitable pocket shall be provided on the inside of the door for the load distribution schedule.

**3.4.4.9** A copper neutral busbar with dimensions, 25mm x 270mm x 6mm shall be mounted in an easily accessible location at the bottom of the AC side of the enclosure. The busbar shall have a minimum of 15mm x 6.5mm termination points fitted with 25mm chrome plated bolts, with flat – and spring washers and 2 nuts per bolt.

**3.4.4.10** Washing lines made from 10mm round bar shall be fitted below the MCB terminals for ease of termination.

#### **3.4.5 19" Distribution Modules**

**3.4.5.1** Module plates shall be manufactured from mild steel of 1.6mm thickness.

**3.4.5.2** Each module plate shall be 482.6mm from edge to edge.

**3.4.5.3** The mounting holes shall be slotted and shall be 10.30mm wide and 6.80mm high. The horizontal distance between the hole's centres shall be 465.10mm. The spacing and size of the holes, similar to all other dimensions and tolerances, shall conform to the latest version of the IEC 60297-1 specification and shall be for the closed hole/slot type. The IEC specification is the only source for manufacturing dimensions.

**3.4.5.4** The bends at the edges shall be done in such a way that the gap between butting plates is minimised. Special care must be taken on the portion that overlaps the door mounting edges with a view to producing a cabinet fitted with blanking plates with an overall aesthetically pleasing appearance.

**3.4.5.5** The earth stud on the back plate should not be under the loom but rather on the other side of the trunking for access. The face plate also needs earthing stud fitted on the rear, right hand side, i.e. closest to the door hinge, internal to the cabinet. The stud shall be fitted with a spring or a serrated washer, plain washer and the fastening nut.

**3.4.5.6** When supplied pre-fitted into a cabinet, all modules shall be bonded to the earthing stud by means of green PVC insulated 1000VAC multi-strand 2.5mm<sup>2</sup> copper wire.

**3.4.5.7** The modules shall consist of a front plate (face plate) and a back plate (terminal plate) which are connected with a loom. In the case of the AC and DC distribution modules the face plate shall be removable with the MCBs mounted on a bracket on the inside of the swing frame panel door. The face plate shall be bonded to the earth stud / terminal on the terminal plate. The bracket should have reef nuts to fasten it to the panel; this is for ease of installation.

**3.4.5.8** The supplier shall also buy out the 19 inch swing frame cabinet and blanking plates from existing approved Eskom suppliers. If required in the schedules a swing frame panel, fully populated with requested distribution modules, may be supplied. The following specification shall apply: 240-74997861, Distribution Specification for a Swing Frame Panel (19" rack) and blanking plates.

### **3.4.6 Cable gland plates**

**3.4.6.1** Pre-drilled, removable gland plates or knockout holes shall be provided for cables entering the enclosure from the bottom and the top.

**3.4.6.2** The removable gland plates shall be fixed to the panel using hexagon head screws to facilitate easy removal and fitted as indicated on the drawings.

**3.4.6.3** The gland plates shall be constructed from 2mm thick, hot dip galvanised, mild steel (indoors) or 3CR12 (outdoors) and shall be sufficient for the AC, DC and alarm cables.

**3.4.6.4** Cable gland holes shall be arranged to permit short direct cable tails between gland plate and terminals, allowing generous working space for installing the size of cable specified.

### **3.4.7 Corrosion protection and paint**

**3.4.7.1** All surface preparation, the application of the primer coat and finishing coat shall be in accordance with the requirements of DSP\_34-1658, Distribution Standards – Part 0: Corrosion Protection Specification for New Indoor and Outdoor Distribution Equipment, Components, Materials and Structures Manufactured from Steel.

**3.4.7.2** All colours shall be according to SANS 1091, National colour standard.

**3.4.7.3** The Yard AC Distribution Board and Outdoor Plug JB enclosure shall be texture powder coated to colour "Light Grey", code G29, whereas the inserts and stand-off brackets shall be smooth powder coated colour "White".

**3.4.7.4** The Wall Mounted AC/DC Distribution Board enclosure shall be texture coated to colour "Light Grey", code G29, whereas the AC and DC compartment cover plates shall be respectively smooth powder coated colour "White" and "Red".

**3.4.7.5** All 19" AC modules shall be texture powder coated to colour "Light Grey", code G29.

**3.4.7.6** All 19" DC modules shall be texture powder coated to colour "Signal Red", code A11.

**3.4.7.7** Gland plates shall be unpainted.

### **3.4.8 Component layout**

**3.4.8.1** The layout of components shall be subject to Eskom's approval, and the terminals of components shall be readily accessible when the equipment is fully wired.

**3.4.8.2** The distance between the lowest terminal for external cabling and the cable gland plate shall allow for cable entry and bending before tails are "peeled-off" to the terminals. This applies in particular to heavy cables.

**3.4.8.3** Power circuitry and control circuitry shall be segregated with the interconnections minimised and arranged for maximum safety and reliability.

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**3.4.8.4** All main components and modules shall be arranged for easy access through the front door, as specified, including the terminals for connection of external cables.

**3.4.8.5** The components shall be arranged so that all necessary adjustments and fault diagnosis can be done safely. In particular, any live parts at mains and DC voltage shall be fully insulated and arranged so that they are not a safety hazard to personnel working in an energised unit.

**3.4.8.6** If AC and DC voltages are housed in the same enclosure there shall be a mechanical separation between the two distribution sections. The DC section shall be identified by a red painted MCB cover plate. This is for the wall mounted AC/DC Distribution Boards.

**3.4.8.7** For 19" AC/DC panel no physical separation of the AC and DC voltages is practical. The back plate and face plates of all DC voltage modules are to be coloured "Red".

### **3.4.9 Wire sizing**

All wiring shall conform to the code of practice for the wiring of premises, SANS 10142-1: The wiring of premises Part 1: Low-voltage installations, inclusive of any amendments. All wiring shall be compatible with the protection device protecting it and it shall be able to carry the MCB fault current.

### **3.4.10 Labels and nameplates**

**3.4.10.1** All labelling shall comply with 240-62629353; Specification for Panel Labelling Standard.

**3.4.10.2** All label schedules are indicated on the drawings.

**3.4.10.3** All fuses, control devices, meters, lamps and relays shall be suitably labelled to Eskom's approval.

**3.4.10.4** Positioning of labels on the cabinets shall be subject to Eskom's approval.

**3.4.10.5** For the outdoor cabinets, the Yard AC Distribution Boards and Outdoor Plug JB's, the labels shall be mounted in slides (guides) in order to prevent them from moving. Slides are to be permanently fixed to cabinets.

**3.4.10.6** For the indoor cabinets and modules, double sided tape or other approved means may be used. The method is subject to Eskom's approval and shall be effective for at least a period of 15 years.

**3.4.10.7** All labelling are to be black lettering on a white background, engraved. 240-62629353; Specification for Panel Labelling Standard

**3.4.10.8** Each cabinet and module shall be provided with a durable weatherproof information label, which shall contain

**3.4.10.9** the following minimum information:

- i. Supplier's name, physical address, contact telephone number, type number and serial number (for quality and traceability)
- ii. Eskom's order number
- iii. Date of manufacture

**4. List of items required on contract**

Item no.	SAP Number	Description	Buyers Guide No. D-DT-	Drawing No. D-DT-	Qty
Yard AC Distribution Board					
	0185221	Single control Yard AC distribution board (with distribution and termination modules)	9200	11200	TBD
	0185222	Dual control Yard AC distribution board (with distribution and termination modules)	9200	11200	TBD
	0185223	Dual control Yard AC distribution board (without distribution and termination modules)	9200	11200	TBD
		Outdoor Plug JB Type A (With ELU)		11226	TBD
		Outdoor Plug JB Type B (No ELU)		11227	TBD
High corrosion paint option for Yard AC Distribution Board					
	XXXX	Corrosion protection for more corrosive environments to SCSSCAAP9 specification DS133. (Please ensure that you mark the quantity to equal the amount of Yard AC Distribution Boards ordered for the more corrosive environment)	XXXX	XXXX	
2 x 24 Way & 2 x 36 Way Relayhouse AC/DC Distribution Boards					
	0175660	24/24 Way relayhouse AC/DC distribution board (wall mounted)	9201	11220	TBD
	0175661	36/36 Way relayhouse AC/DC distribution board (wall mounted)	9202	11221	TBD
Standard 19 Inch Modules (labels and label schedules included)					
	0175662	Main module (to be mounted in 19 inch, floor standing cabinet)	9203	5606	TBD
	0175664	3 Phase AC module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD
	0216215	1 Phase AC module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD
	0216216	DC supply module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD
	0175669	AC supply module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD
	0185229	DC interface module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD
	0185251	19 Inch Dual Control Module (to be mounted in 19 inch, floor standing cabinet)	9203	5606	TBD
	0186797	Main AC Incoming Module (to be mounted in 19 inch, floor standing cabinet)	9203	11218	TBD

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Item no.	SAP Number	Description	Buyers Guide No. D-DT-	Drawing No. D-DT-	Qty
		The single-phase Incoming AC supply module (to be mounted in 19 inch, floor standing cabinet)		11234	TBD
		Eskom Telecomms Distribution Board		11211	TBD
Standard 19 Inch Modules (labels and label schedules included, excluding the panel and blanking plates)					
	0186847	Assembly, 14/10 way AC/DC DB The following modules: 1 x DC interface module (0185229) 1 x DC supply module (0216216) 1 x 3 Phase AC module (0175664) 1 x 1 Phase AC module (0216215) 1 x AC supply module (0175669)	9204	11216	TBD
	0186848	Assembly, 14/20 way AC/DC DB The following modules: 1 x DC interface module (0185229) 2 x DC supply module (0216216) 1 x 3 Phase AC module (0175664) 1 x 1 Phase AC module (0216215) 1 x AC supply module (0175669)	9204	11217	TBD
	0186849	Assembly, 28/20 way AC/DC DB The following modules: 1 x DC interface module (0185229) 2 x DC supply module (0216216) 1 x 3 Phase AC module (0175664) 2 x 1 Phase AC module (0216215) 1 x AC supply module (0175669)	9204	11218	TBD
	0186850	Assembly, BB s/s AC/DC DB The following modules: 1 x Main AC incoming module (0186797) 1 x DC interface module (0185229) 1 x DC supply module (0216216) 1 x 1 Phase AC module (0216215) 1 x AC supply module (0175669)	9204	11219	TBD
		Eastern Cape - AC Panel The following modules: 1 x Chop-over module 2 x 3 Phase AC module 3 x 1 Phase AC module 1 x AC supply module 1 x 3 phase Yard Lights Module		D-ECOU-111	TBD

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Item no.	SAP Number	Description	Buyers Guide No. D-DT-	Drawing No. D-DT-	Qty
		Eastern Cape - DC Panel The following modules: 3 x Main DC module 3 x Backup DC module 3 x Spring Rewind module		D-ECOU-112	TBD
		Eastern Cape - AC/DC Emergency Supply		D-ECOU-115	TBD
		Eastern Cape - AC/DC DB The following modules: 1 x DC Main module 1 x DC Backup 1 x DC Spring Rewind module 1 x Main module 1 x Chop-over module 1 x 3 Phase AC module 1 x 1 Phase AC module 1 x AC supply module 1 x 3 phase Yard Lights Module		D-ECOU-117	TBD
		Eastern Cape – 36 way AC/DC Wall Mount		D-ECOU-119	TBD
		Eastern Cape – Yard AC Chop-over		D-ECOU-131	TBD

## 5. Testing and quality assurance

### 5.1 General

All instruments used for testing shall be of suitable quality and of sufficient accuracy for the particular test application. Eskom reserves the right to request instruments that have been certified by the National Calibration Service. The cost of obtaining such certificates shall be for the supplier's account. In order to enable Eskom to witness tests, the contractor shall inform Eskom in writing at least three weeks prior to commencement of type testing and at least two weeks prior to routine testing.

### 5.2 Type testing

- a) When specified, prior to routine production, a prototype of each type of unit shall be provided for type testing to establish performance characteristics and to demonstrate compliance with all requirements of this specification.
- b) The contractor shall draw up a prototype test schedule for Eskom approval prior to prototype testing.
- c) The cost of a prototype unit shall be for the account of the supplier.
- d) Eskom representatives shall witness type tests at the supplier's works. Eskom will at the same time examine the prototype with regard to mechanical construction, layout and labelling.

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- e) Type tests at the supplier's works shall include operational tests and wiring tests and any additional tests that may be required by Eskom.
- f) In the event of any changes that may be necessary after type testing of a prototype, written approval shall be obtained from Eskom prior to the introduction of such changes.
- g) Repeated type tests as a result of changes in the design shall be at Eskom's discretion.

### 5.3 Routine testing

- a) The supplier shall, at his works, subject each unit to routine tests. The supplier shall draw up a routine test schedule for Eskom's approval prior to routine testing.
- b) Witnessing of routine tests shall be left to the discretion of Quality Management Department Sustainability. In the event of routine tests not being witnessed, Eskom reserves the right to request verification of any test results.
- c) The routine tests shall include operational tests, wiring tests and any additional tests requested by Eskom.

### 5.4 Operational tests

- a) The units shall be subjected to operational tests, sufficient in number and scope to prove that the equipment fully complies with the operational, protection and alarm requirements of this specification.
- b) The number and scope of the operational tests shall be agreed upon between the supplier and Eskom during type testing of the prototypes.

### 5.5 Continuity tests

- a) The wiring shall be tested for continuity where the continuity test shall give a reading of less than  $0.1\Omega$ . Where MCBs are used, they shall be all switched ON.
- b) The wiring insulation to earth as well as between unique circuits shall be checked with a  $500 V_{DC}$  insulation resistance tester. Ensure that a reading of infinity ohms is obtained between any part of the circuit and the chassis and also any separate circuit. The test must be performed with the MCB in the OFF and ON positions, where applicable. This test shall also be applied between each individual circuit.
- c) Infinity with a  $500 V_{DC}$  insulation resistance tester shall be greater than  $20M\Omega$ .
- d) The insulation resistance tester must be periodically tested and calibrated by an accredited test laboratory. The supplier or sub-contractor shall be able to provide proof that these tests are performed at least once in 12 months. A test certificate shall accompany each unit.

### 5.6 Test certificates

- a) The test certificates shall be kept on file with the supplier for the duration of the contract period. A copy of the test certificate shall be supplied with each order.
- b) The test certificate shall as a minimum have the following information:
  - Type of product tested
  - Person performing the test
  - Date of test
  - Signature
  - Continuity test reading – detail the worst reading in ohms
  - Insulation resistance test reading – detail the worst reading in ohms

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- Item serial no
- Test meter detail – type, serial number, date of last accuracy test

## 5.7 Clearance for despatch

The supplier shall obtain agreement from Quality Management Department Sustainability before despatching the equipment. This agreement shall be confirmed on the routine test certificates.

## 6. Transport, labelling and packaging

### 6.1 Transport

- a) The price quoted for the transport (see 2) shall include the loading of the items between the place of manufacture and the relevant place of delivery. Delivery shall be “free” within a radius of 100 km of the supplier and incremented as detailed below.

**Table 2: Transport costs**

Item No.	Distance	Cost
XXX	0 – 100 km	“No charge”
XXX	101 – 300 km	X cost
XXX	301 – 600 km	X cost
XXX	601 – 900 km	X cost
XXX	901 – 1200 km	X cost
XXX	1201 – 1500 km	X cost
XXX	1501 – 1800 km	X cost
XXX	1801 – 2100 km	X cost

- b) The truck or vehicle used shall be the enclosed type or at least have a waterproof tarpaulin over the load.
- c) Prior to despatch the supplier shall telephonically confirm the availability of a receiving agent.
- d) The contractor shall be responsible for ensuring that the proper mechanisms are available for both offloading and placement.

### 6.2 Labelling

- a) The package shall be clearly labelled with the station name, full delivery address, Eskom and supplier order number, despatch date and the contents of the package.
- b) Where an order contains clearly marked sub orders (on the order documentation), the packaging of this order shall enable the separate “sub orders” to be easily identified and easily separated. This should be done without the opening of crates or the movement of packages from one crate / consignment to another.

### 6.3 Packaging

- a) The products ordered shall be packed in high specification impact resistant corrugated cardboard with a waterproof outer plastic covering. This shall ensure that the equipment is protected from damage in the event of a light drizzle as well as protected from bumps and scratches that could occur from normal handling and transport.
- b) The packaging shall be suitable to protect the equipment from transport damage over long distance by road.

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## 7. Drawings

Table 3: Drawings

Description	Approved Drawing
Yard AC Distribution Board	D-DT-11200
Yard AC Distribution Board Without Distribution	D-DT-11201
AC Distribution Panel 400V 3 Phase AC Yard Lights Dist Module	D-DT-11204
Eskom Telecomms Distribution Board	D-DT-11211
14/10 Way AC/DC Panel	D-DT-11216
14/20 Way AC/DC Panel	D-DT-11217
28/20 Way AC/DC Panel	D-DT-11218
Brickbuild S/S AC/DC Panel	D-DT-11219
24/24 Way Distribution Boards	D-DT-11220
36/36 Way Distribution Boards	D-DT-11221
Outdoor Plug JB Type A (With ELU)	D-DT-11226
Outdoor Plug JB Type B (No ELU)	D-DT-11227
Type H: VT Power 19' Interface Module	D-DT-11228
Eastern Cape - AC Panel	D-ECOU-111
Eastern Cape - DC Panel	D-ECOU-112
Eastern Cape - AC/DC Emergency Supply	D-ECOU-115
Eastern Cape - AC/DC DB	D-ECOU-117
Eastern Cape – 36 way AC/DC Wall Mount	D-ECOU-119
Eastern Cape – Yard AC Chop-over	D-ECOU-131

## 8. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Richard McCurrach	Senior Manager – PTM&C CoE
Deon van Rooi	Metering, DC & Security Technologies Manager – PTM&C CoE (Acting)
Kashveer Jagdaw	DC & Auxiliary Supplies Study Committee Chairperson

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## 9. Revisions

This revision cancels and replaces revision no. 0 of specification no. 34-1301

Date	Rev	Compiler	Remarks
Jan 2018	3	C van Schalkwyk	Added section 3.2.2.7 Automatic Transfer Switching Equipment Defined the MCB short-circuit breaking capacity as $I_{CS}$ . Added the definitions of $I_{CS}$ and $I_{CU}$ . Change the timer in the control circuit (3.2.2.1. i) to delay-on-pickup timer.
June 2015	2	C van Schalkwyk	Updated Environmental conditions Updated document references. Added an option for an automatic change over switch. Added the Outdoor Plug JB Added an option for other construction materials for the Yard box and Outdoor Plug JB. Change the back plate and faceplate colour of the 19" DC voltage modules to red. Removed the 3 phase plugs from the Wall mount panel and the 19" panel. Added the single-phase Incoming AC supply module. Updated drawing list. Added Eastern Cape configurations to contract items list. Updated contract items list.
March 2014	1	K Naicker	Document reformatted into new template. Reference number changed from DSP_34-1301 to 240-75658628

## 10. Development team

The following people were involved in the development of this document:

- Christine van Schalkwyk
- Kuben Naicker
- Richard Vlantis
- Thomas Jacobs
- Trevor Pope

**Annex A – Technical Schedules A and B**

Tenderer's name: .....

Date: .....

Signature: .....

Item	Description	Schedule A	Schedule B
3.1	General		
3.1.1	Environmental conditions: Altitude Relative humidity Lightning Outdoor air temperatures: Maximum Daily average Yearly average Minimum Equipment room air temperatures: Maximum Yearly average Minimum	Comply 2200m 10% - 85% High  50°C 30°C 20°C -10°C  50°C 25°C -5°C	
3.1.2	Cooling requirements	Natural convection	air
3.2	Operational requirements		
3.2.1	General	Information	
3.2.2	Yard AC Distribution Board:	Comply	
	Drawing sets	D-DT-1200	
	Control modules operation	As specified	
	Distribution module	As specified	
	Termination module	In accordance with 240-70413291	
	Incoming supply selector switch	As specified	
	Indication lamps	As specified	
	Plug box	As specified	
	Automatic change over switch	Specify	
	Different configurations	As specified	
3.2.3	Outdoor Plug JB	As specified	
3.2.4	Wall Mounted AC/DC Distribution Board:	Comply	
	Drawing sets	D-DT-11220 and D-DT-11221	

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Item	Description	Schedule A	Schedule B
	Plug box	As specified	
3.2.5	19" AC/DC Distribution Board:	Comply	
	Drawing sets	D-DT-5600, D-DT-11216 to D-DT-11219	
	Operation and modules	As specified	
3.3	Electrical requirements		
3.3.1	AC supply voltage	As specified	
3.3.2	DC supply voltage	As specified	
3.3.3	Lightning and surge protection	SANS 61643	
3.3.4	Miniature circuit breakers and isolating switches	Comply	
	DC MCBs: Number of poles Rated operating voltage across the poles Short-circuit capacity I <sub>CS</sub> Time constant Utilisation/selectivity category Pollution degree Suitable for isolation Tripping curve	2-pole 140Vdc or 280Vdc 5kA 4ms A 3 or higher Yes C	
	AC MCBs: Number of poles Rated operating voltage Short-circuit capacity I <sub>CS</sub> Utilisation category Pollution degree Suitable for isolation Tripping curve	As specified As above 5kA A 3 or higher Yes C	
	Source supply position on MCB Load supply position on MCB	Top Bottom	
3.3.5	Contactors	SANS 60947-4-1	
3.3.6	Earth leakage protection	SANS 767-1	
3.3.7	Plug socket outlets	Comply	
	1-phase socket outlets	SANS 164 Parts 1 and 2	
	3-phase socket outlets	SANS 60309 Parts 1, 2 and 4	
3.3.8	Termination and wiring	SANS 767-1	
	Colour coding	As specified	
	Trunking required	Yes	

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Item	Description	Schedule A	Schedule B
	Lugs and crimping	DST_34-2151	
	Terminal blocks	240-70413291	
	Yard AC Distribution Board	As specified	
	Wall Mounted AC/DC Distribution Board	As specified	
	19" AC/DC Distribution Board modules	As specified	
3.3.9	Earthing and bonding	As specified	
3.3.10	DC voltage drop	<500mV	
3.4	Mechanical construction and layout		
3.4.1	General	As specified	
	Cabinets	As specified	
	Door gasket lifetime	15 years	
	Pad lockable doors	Yes	
3.4.2 & 3.4.3	Yard AC Distribution Board & Outdoor Plug JB:		
	Enclosure material	Specify	
	Back plates and stand-off brackets	Specify	
	Other external parts and fixtures	3CR12 or brass	
	IP rating	IP 53	
	Earth stud	60mm, M16, brass	
	Neutral bar	25x270x6mm copper	
3.4.4	Wall Mounted AC/DC Distribution Board:		
	Enclosure material	1.6mm electro- galvanised mild steel	
	IP rating	IP 45	
	Earth stud	2 x 50mm, M10, brass	
	Neutral bar	25x270x6mm copper	
3.4.5	19" Distribution Modules:	As specified	
	Material	1.6mm electro- galvanised mild steel	
	19" dimensions	IEC 60297-1	
	Fitment of modules into a 19" swing frame panel required.	No	
	Swing frame cabinet detail	240-74997861	
3.4.6	Cable gland plates:	As specified	
	Material for outdoor cabinets	2mm 3CR12	

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Item	Description	Schedule A	Schedule B
	Material for indoor cabinets	2mm hot dip galvanised mild steel	
3.4.7	Corrosion protection and paint		
	Corrosion protection as per DSP_34-1658, specification DS1 (Powder coating).	Comply	
	Yard AC Distribution Board Colours (to SANS 1091): Enclosure: Inserts and stand-off brackets:	Colour G29, texture White, smooth	
	Wall Mounted AC/DC Distribution Board Colours (to SANS 1091): Enclosure: AC compartment cover plate: DC compartment cover plate:	Colour G29, texture White, smooth Red, smooth	
	19" Modules (to SANS 1091) AC	Colour G29, texture	
	19" Modules (to SANS 1091) DC	Colour R, texture	
	Gland plates to be unpainted.	Comply	
3.4.8	Component layout	As specified	
3.4.9	Wire sizing	As specified	
3.4.10	Labels and nameplates	As specified	
3.4.11	Standard document	Comply	
0	List of items required on contract	As specified	
5	Testing and quality assurance	As specified	
5.1	General	Comply	
5.2	Type Testing	As specified	
5.3	Routine Testing	As specified	
5.4	Operational test	As specified	
5.5	Continuity test	As specified	
5.6	Test certificates	As specified	
5.7	Clearance for despatch	As specified	
6	Transport, labelling and packaging	Comply	
6.1	Transport	As specified	
6.2	Labelling	As specified	
6.3	Packaging	As specified	