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|  Eskom | Standard | Technology |
|--|-----------------|-------------------|

Title: **AC/DC RETICULATION
EQUIPMENT FOR BREAKER-
AND-A-HALF SUBSTATIONS**

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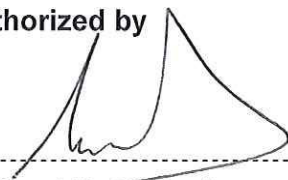


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1. Introduction

This document specifies Eskom's requirements for the indoor AC and DC distribution boards, and outdoor (structure mounted) JB's used in breaker-and-a-half substations. The outdoor AC Boards are covered by a separate specification entitled "Technical Specification for Outdoor Type –Tested AC Reticulation Assemblies for use in Transmission 765kV Breaker-and-a-Half Substations".

2. Supporting clauses

2.1 Scope

This document details the manufacturing of the following equipment;

- VTJB 0700
- 230V Plug Box – Type BH
- 220V/100A DC Board DMK – DC – Type 1
- 400V AC Distribution Board DMK – AC – Type 1
- 230V AC Distribution Board - AC Type 4

Specific Technical A/B schedules are required to be completed by all suppliers. These technical requirements are specific for each distribution board and junction box. General A/B schedules which refer to the general compliance of this document are also required to be completed by all suppliers.

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, packaging, delivery and off-loading contract (Eskom National Contract, ENC) for the manufacturing of AC/DC reticulation equipment, for use at Transmission breaker-and-a-half substations.

Subsequent to the award of the ENC, once manufacture of any of the AC/DC equipment 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 completion of the FAT, the functional design specification will be added to the ENC. Additionally, a revised set of Technical A/B schedules will be completed and submitted with the contract.

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 this section.

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 10142-1, 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] VC 8003, Manually Operated Switches for Fixed Installations, SANS, Latest
- [2] VC 8006, Electric cables- flexible cords and flexible cables, SANS, Latest

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- [3] VC 8075, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)–Parts 1-6, SANS, Latest
 - [4] VC 8035, Earth-leakage protection units – Part 1 Fixed earth leakage protection units., SANS, Latest
 - [5] VC 8036, Moulded-case circuit-breakers up to 125 A and up to 10kA., SANS, Latest
 - [6] SANS 1213, Mechanical cable glands, SANS, Latest
 - [7] SANS 1091, National Colour Standards for Paints, SANS, Latest
 - [8] SANS 1507, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3 300 V), SANS, Latest
 - [9] SANS 60947, Low-voltage switchgear and controlgear: Contactors and motor starters Electro-mechanical contactors and motor-starters, SANS, Latest
 - [10] SANS 10142-1, The wiring of premises part 1: low-voltage installations, SANS, Latest
 - [11] SANS 556-1, Low-Voltage Switchgear PART 1: Circuit-Breakers, SANS, Latest
 - [12] SANS 156, Miniature Circuit-Breakers, SANS, Latest
 - [13] SANS 1195, Busbars, SANS, Latest
 - [14] SANS 60947-3, Low-voltage switchgear and controlgear. Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units., SANS, Latest
 - [15] SANS 1574, Electric flexible cores, cords and cables with solid extruded dielectric insulation Part 1: General, Part 3: PVC insulated cores and cables, Part 4: Rubber insulated cores and cords, Part 5: Rubber insulated cores and cables., SANS, Latest
 - [16] SANS 60044, Instrument transformers, Part 1: Current transformers, SANS, Latest
 - [17] SANS 60529, Degrees of protection provided by enclosures (IP Code), SANS, Latest
 - [18] SANS 60614 , Conduits for electrical installations – Specifications Part 1: General requirements, Part 2: Particular specifications for conduits Section 5: Flexible conduits., SANS, Latest
 - [19] SANS 60865-1, Short-circuit currents – calculation of effects Part 1: Definitions and calculation methods., SANS, Latest
 - [20] SANS 60947-2, Low-voltage switchgear and controlgear. Part 2: Circuit-breakers., SANS, Latest
 - [21] QM-58, Supplier Contract Quality Requirements Specification, Eskom, Latest
 - [22] 240-75655504, Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard, Latest
 - [23] 240-62629353, Specification for panel labelling, Eskom, Latest

2.2.2 Informative

- [24] 32-9, Definition of Eskom documents, Eskom Document Centre, Latest
- [25] 32-644, Eskom documentation management standard, Eskom Document Centre, Latest
- [26] 474-65, Operating manual of the Steering Committee of Technologies (SCOT), Vinod Singh, Latest

2.3 Definitions

2.3.1 General

| Definition | Description |
|----------------------------|---|
| Data Sheets | All drawings, tabulations, sketches, and relevant documentation which Eskom shall submit with an enquiry, to clearly indicate to a bidder or supplier the technical, electrical and physical requirements of the completed equipment. |
| Padlocking facility | Part of the assembly or component that allows one to insert a padlock for locking purposes during maintenance. |
| The purchaser | Eskom Holdings Limited |
| The supplier | A successful tenderer, with whom a supply contract is placed. In other words, all tenderers are potential suppliers. |

2.3.2 Disclosure classification

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

2.4 Abbreviations

| Abbreviation | Description |
|---------------------|--|
| AC | Alternating current |
| DB | Distribution Board |
| DC | Direct Current |
| DMK | Diameter Marshalling Kiosk |
| ENC | Eskom National Contract |
| FAT | Factory Acceptance Test |
| IP | Ingress Protection |
| JB | Junction Box |
| LED | Light Emitting Diode |
| MCB | Miniature Circuit Breaker |
| MCCB | Moulded Case Circuit Breaker |
| PTM&C | Protection, Telecommunication, Measurement and Control |
| SANS | South African National Standards |
| SDB | Station Distribution Board |
| TDB | Transformer Distribution Board |
| VTJB | Voltage Transformer Junction Box |

2.5 Roles and responsibilities

The supplier is to take cognisance of the following with regards to the tender returnables and the General and specific Technical A/B schedules:

- a) An incomplete tender submission will be deemed as non-compliant.

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- b) An alternative offer shall only be considered if the main offer is compliant.
- c) General and specific schedule A: The Purchaser's Requirements.
- d) General and 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.

2.6 Legal Requirements

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.

2.7 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.

The final visual inspection by the purchaser's quality assurance representative shall be performed prior to dispatch to sites.

2.8 Related/supporting documents

Not applicable.

3. Technical Specification

This specification defines the purchaser's requirements for the following equipment

- a) VTJB 0700
- b) 230V Plug Box – Type BH
- c) 220V/100A DC Board DMK – DC – Type 1

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- d) 400V AC Distribution Board DMK – AC – Type 1
- e) 230V AC Distribution Board - AC Type 4

The VTJB 0700 and the 230V Plug Box are outdoor junction boxes. All AC and DC Distribution Boards are for indoor use only. All of the above equipment shall be delivered complete with the necessary connections, interconnecting wiring, circuit breakers, supporting steelwork, bolts, nuts, washers, labels and necessary sundries to provide a complete assembly. Nothing in this specification shall lessen the contractor's obligations detailed in any other documents forming part of the contract.

The latest revision of the documents must be read in conjunction with this specification. However, in cases of conflict, the provisions of this specification shall take precedence.

3.1 Construction

Outdoor JB's (VTJB 0700 & 230V Plug box) shall be fabricated from 3CR12 (corrosion resisting steel) with a minimum thickness of 1.6 mm. These boxes shall be vermin proof and suitable for structure mounting outdoors. AC and DC boards shall be constructed from 2 mm mild steel and to be suitable for floor mounting as specified according to Eskom drawing for indoor mounting. All outdoor equipment shall be manufactured with an IP rating of 54. All indoor AC and DC boards shall be manufactured with an IP rating of 53. All doors shall have an earth stud. All individual metal parts used in the construction of the outdoor JB's and the AC/DC Distribution boards must have an earth stud.

3.2 Doors

Each door (except for plug boxes) shall be provided with a minimum of two non-ferrous handles of the wedge action type, capable of being padlocked in the fully closed position. A minimum of two non-ferrous hinges of substantial section and approved pattern shall be provided per door, together with an arrester bar.

Doors shall be provided with gaskets of neoprene or approved material. Rubber or felt gaskets are not acceptable. Doors shall be of the double step design. Door stays shall be off the hook and eye type, not window stay type. For the 230V AC Distribution board, DMK AC and DC boards the doors must be swing frame.

3.3 Anti-condensation heater

A 220V AC, 30 Watt heater unit must be installed in the VTJB 0700 to prevent condensation. The position of the heater is shown in the VTJB 0700 drawing. The heater terminals live part needs to be protected against electrocution.

3.4 Drainage

Each outdoor junction box shall be provided with at least one brass, copper or nylon gauze covered drain hole of minimum diameter 25 mm and positioned at the lowest point of the box. The internal design of the box and the arrangement of components shall be such that drainage is not obstructed. Drain holes of 6 mm diameter shall be provided in the lower door-fold.

3.5 Gland Plates

Removable gland plates, made from 2 mm 3CR12 (unpainted) pre-punched or drilled with the number of holes as shown on the drawing shall be provided for the outdoor junction boxes. Hole plugs shall be provided for gland plates that are drilled. Gland plates made from 3 mm galvanized mild steel (unpainted) pre-punched or drilled with the number of holes as shown on the drawing shall be provided for the indoor distribution boards.

3.6 Corrosion Protection

After fabrication, metal surfaces including doors and removable covers shall be prepared and finished in accordance with corrosion protection standard 240-75655504. The exterior colour shall be dark grey, (semi-gloss) to G12 SANS 1091 Poly-Urethane coated. Interior colour shall be white gloss 1091 Poly-Urethane coated.

3.7 Damaged Paint Work

Paint work damaged during transport and delivery shall be made good as per manufacturer repair specification at no cost to the purchaser. If site re-painting is necessary, the equipment and labels shall be carefully masked and any overpaint which occurs in spite of the masking must be removed.

3.8 Nuts, Bolts, Washers and Screws

All nuts, bolts and washers used for the construction are to be stainless steel. Screws can be cadmium plated. Where referred to as per drawings, brass bolts, nuts and washers must be used.

3.9 Base Frame

A suitable base frame made of 3 mm mild steel plate hot-dip galvanized to SANS ISO 1461 shall be provided as per drawing for the indoor AC and DC distribution boards.

3.10 Wiring

All wiring shall be carried out in general-purpose 600/1000 V SANS approved multi-strand PVC wire. The cross sectional area of all wiring shall be suitable for the maximum expected current in any circuit. Joints or splices in internal wiring are not acceptable. Not more than two conductors shall be connected to any one side of a terminal and where two conductors are connected to a terminal, care must be taken to ensure that the conductors are of the same size and that lugs and ferrules are fitted to the conductors in such manner as to avoid reduction in clearances. More than one wire per lug shall not be allowed. Stripping of insulation is to be carried out so that no damage to conductors occurs. Wiring damaged (nicked) during the stripping process will be rejected. Stripping tools permitting the length of the "strip" to be preset shall be used. The "strip" shall be 1 mm longer than the barrel of the terminating lug. All holes through which wiring must pass shall have their edges protected using grommets.

All control wiring shall be terminated with approved pre-insulated, crimped or type connectors. All lugs must match the type of termination on the equipment. All terminations shall be made with the tool recommended by the manufacturer of the lugs. Crimping tools shall be of the type, which will not release the termination during normal operation, until the conductor crimp has been correctly formed. All wires and cables larger than 6 mm² shall be terminated with an approved lug. The lug shall be crimped with a hydraulically actuated die tool as recommended by the manufacturer of the lug. There shall be no bare wire exposed between a lug and the insulation of the wire to which it is crimped.

The lugs selected shall be the correct barrel size for the size of wire or cable with which they are to be used, and the dimensions of the tongue shall match the stud, screw or aperture of the terminal to which they will be connected. Sample crimped ends, selected at random, may be subjected to tests in situ, to prove their mechanical strength. Such tests will consist of an axial pull, equivalent to approximately 60% of the nominal-breaking load of the conductor only, applied by means of a spring balance or similar device. For the purpose of this specification, the force to be applied when testing crimped terminations on 2.5 mm² shall be 270 N.

Electrical clearance between uninsulated copper bars, live to neutral and live to earth shall be not less than 20 mm or shall be sufficiently shrouded/insulated with non-flammable insulation material. Warning labels shall be fitted on all doors giving direct access to live bus-bars or terminals.

Wiring leads shall be marked at both ends with an approved type of ferrule, permanently marked with black letters impressed on a white or yellow background. Interlocking slip-on type ferrules shall match the size of wire onto which they are fitted.

Ferrules shall be fitted so as to read from left to right on vertical terminal strips and to read from insulation to crimped lug in the case of switch and fuse connections. On horizontal terminal strips ferrules shall be fitted so as to read from bottom to top. Terminals shall be of a type and make approved by Eskom.

Rail mounted spring loaded type screw clamp loaded type; the terminals shall be of the type which compresses the terminations between two plates by means of terminal screws.

Rail mounted stud type; two terminal studs shall be provided for each "way" and shall be of sufficient length to accommodate two ring, terminations in addition to a nut, plain and spring washer. Rail mounting is preferred and the terminals shall be the pressure spring loaded type.

3.10.1 VTJB 0700 – wiring

4 mm² stranded copper wire shall be used for the power circuits. 2.5 mm² stranded copper wire shall be used on for the MCB auxiliary contacts

3.10.2 Plug Box Type BH – wiring

4 mm² stranded copper wire shall be used.

3.10.3 DC Board DMK Type 1 - wiring

25 mm² multi-stranded wire must be used between the Main 1 and Main 2 supply MCB's and the selector switch. 25 mm² multi-stranded wire must be used between the Main 1 and Main 2 supply MCB's and the WFF35 supply terminals. 16 mm² multi-stranded wire must also be used between the selector switch and the Motorised Isolator and Spring Rewind MCB modules. 6 mm² wire must be used to perform looping between MCB's in the Motorised Isolator and Spring Rewind modules. Motorised Isolator and Spring Rewind modules must be supplied with two positive and two negative 16 mm² wires from the selector switch. One positive wire must be terminated on the first MCB of the group of MCB's and the second positive wire must be terminated on the last MCB of the group. This also applies to the negative wire.

4 mm² wire shall be used on the load side of all MCB's in the Motorised Isolator and Spring Rewind modules. 2.5 mm² wire must be used to perform looping between MCB's in the Secure Supply modules. 2.5 mm² wire shall be used on the load side of all MCB's in the Secure Supply modules. All control wiring shall be at least 1.5 mm² stranded copper wire. The colour of the control wiring shall be grey. The insulation of positive and negative wires in power circuits shall be red and black in colour, respectively.

3.10.4 400V AC Board DMK Type 1 - wiring

Power cabling used between the WFF70 terminals and the Isolator and between the Isolator and the busbars must be 35 mm² multi-stranded wire. All power cabling must be colour coded. 16 mm² cables must be used between the busbars and the MCB groups. Two 16 mm² cables must be terminated between the busbars and each MCB group. One 16 mm² wire must be terminated on the first MCB of the group of MCB's and the second wire must be terminated on the last MCB of the group. 6 mm² wire must be used to perform looping between MCB's in each group. 2.5 mm² wire shall be used on the load side of all MCB's except MCB 2, 3 and 4 where 6 mm² shall be used.

All control wiring shall be at least 1.5 mm² stranded copper wire. The colour of the control wiring shall be grey or black. The wiring of alarm circuits shall be done in grey or black 1.5 mm² stranded copper wire.

3.10.5 230V AC Board Type 4 - wiring

The terminals to be used shall be either Wuidmuller (spring loaded terminals), Entrelec and Elmex terminals suitable for the wire sizes used. All control wiring shall be at least 1.5 mm² stranded copper wire. The colour of the control wiring shall be grey. All power wiring shall be 16 mm² stranded copper wire. All wiring from the stud terminals to the individual distribution modules shall be done with 16 mm² stranded copper wire. Ferruling is required on the 16 mm² wires as shown in the drawings. Three phase busbars shall be used for connection between the MCB's in each distribution module. 4 mm² stranded copper wire shall be used on the load side of all outgoing MCB's.

3.11 Labels

All external and internal labels on equipment shall bear inscriptions in English. All labels shall be horizontal and parallel to each other and to the equipment with which they are associated. All equipment which as shown in the schematic drawings including terminal rails has to be labelled. The lettering shall be legible when viewed from an angle of approximately 45° from any position (above, below, horizontal) with respect to the label. The width of exposed "black" in standard labels shall not be less than one seventh of the centre height of the letter. Standard vertical, medium lettering shall be used. Narrow or broad type faces are not acceptable. Upper case letters shall be used, except where conventional abbreviations or symbols require the use of both upper and lower case letters (e.g. kVar). The designated colours of the labels shall be as defined in SANS1091. The labels of all equipment are indicated in the drawings. Standard type labels shall be in the following colours as specified:

- Warning labels: White lettering on a red background
- All other function designations: Black lettering on a white background

External and internal labels shall comply with the requirements of Eskom standard for labelling 240-62629353. Only engraved labels made of a 3 layer frafolyte sandwich board will be accepted.

3.12 MCB Locking Brackets

All outgoing MCB's on the AC distribution boards shall be fitted with a lockable bracket. The bracket must be designed such that the MCB can only be locked in the off position. The bracket shall be made of mild steel which can swivel on a steel rod.

3.13 Earthing

All metal parts shall be connected individually and direct to the earth bar via a green 4 mm² PVC copper conductor. All terminal rails should be fitted with an earthing terminal. All electrical components that have a provision for earth, must be earthed. Looping of the earth wire between metal parts will not be acceptable. Each metal part shall have its own earth connected to the earth bar or earth stud. A 40 x 40 x 3 mm copper pad shall be brazed to the outside, and on the right hand side of the 230 V AC plug box and the VTJB 0700. The copper earth pad and the M10 x 50 brass bolt are shown in detail 'a' in the drawings. All gland plates 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 12 mm². The contact resistance between the main earth bar/stud and any earth stud located on doors, gland etc. must not exceed 0.1 ohm.

3.14 MCB's

Miniature circuit breakers (MCB's) shall comply with the requirements of VC8036, SANS 556-1 and SANS 60947-2. The DC MCB's specified are polarity sensitive. The MCB's specified for the Distribution Boards are specific due the cascading principle being applied. All MCB's shall be wired with the source supply at the top, and the load supply at the bottom.

4. Testing

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.

4.1 Type testing

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. The contractor shall draw up a prototype test schedule for Eskom approval prior to prototype testing. The cost of a prototype unit shall be for the account of the supplier. 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. Type tests at the supplier's works shall include operational tests and wiring tests and any additional tests that may be required by Eskom. 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. Repeated type tests as a result of changes in the design shall be at Eskom's discretion.

4.2 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 Transmission Technology Quality Management. 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.

4.3 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.

4.4 Continuity tests

- a) The wiring shall be tested for continuity where the continuity test shall give a reading of less than 0.1 Ω . Where MCB's 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 20 M Ω .
- 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 six months. A test certificate shall accompany each unit.

4.5 Test certificates

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.

The test certificate shall as a minimum have the following information:

- a) Type of product tested
- b) Person performing the test

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- c) Date of test
- d) Signature
- e) Continuity test reading – detail the worst reading in ohms
- f) Insulation resistance test reading – detail the worst reading in ohms
- g) Item serial no
- h) Test meter detail – type, serial number, date of last accuracy test

5. Packaging

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. The package shall be clearly labelled with the sub-station name, full delivery address, Eskom and supplier order number, despatch date and the contents of the package.

6. Transport

The price quoted for the transport (see Table 1) shall include the loading and off-loading of the items from place of manufacture to the relevant place of delivery.

Table 1: Transport costs – (Delivery and off-loading)

| Item No. | Distance | Cost |
|-----------------|-----------------|-------------|
| XXX | 0 – 100 km | X cost |
| XXX | 101 – 200 km | X cost |
| XXX | 201 – 400 km | X cost |
| XXX | 401 – 600 km | X cost |
| XXX | 601 – 800 km | X cost |
| XXX | 801 – 1000 km | X cost |
| XXX | 1001 – 1200 km | X cost |
| XXX | 1201 – 1400 km | X cost |
| XXX | 1401 – 1600 km | X cost |
| XXX | 1601 – 1800 km | X cost |

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

7. Drawings

The construction of the JB's and the DB's shall be according to the approved Eskom Drawings. However if the construction of the JB's and DB's differ from Eskom Master Drawings then then general arrangement drawings (GA's) from the supplier must be submitted to Eskom, for approval, prior to construction. Table 2 indicates the master drawing numbers for the JB's and DB's.

Table 2: Master Drawing numbers for JB's and DB's

| Drawing Name | Drawing No. | Revision |
|--|-------------|----------|
| 400V AC DISTRIBUTION BOARD DMK – AC - TYPE 1 | 0.54/6729 | 5 |
| 230V AC DISTRIBUTION BOARD – AC- TYPE 4 | 0.54/7106 | 1 |
| 220V/100A DC BOARD DMK – AC - TYPE 1 | 0.54/6730 | 3 |
| VTJB 0700 | 0.54/6731 | 3 |
| 230V PLUG BOX – TYPE BH | 0.54/6735 | 3 |

8. Authorization

This document has been seen and accepted by:

| Name | Designation |
|----------------------|--|
| G Topham | Corporate Specialist (Engineering Protection) |
| V Msibi | Chief Technologist Protection |
| H Sithole | Senior Engineer Protection |
| Keineetse Rankunyane | Secondary Plant Manager (Transmission Western Grid) |
| David Sehloho | Secondary Plant Manager (Transmission Eastern Grid) |
| Avhafani Luvhengo | Secondary Plant Manager (Transmission Central Grid) |
| Selby Madau | Secondary Plant Manager (Transmission Northern Grid) |
| Humbulani Tshisevhe | Secondary Plant Manager (Transmission North East Grid) |
| Ellan Phaahla | Secondary Plant Manager (Transmission North West Grid) |
| Gilbert Valentyn | Secondary Plant Manager (Transmission Southern Grid) |
| Rohan Wessels | Secondary Plant Manager (Apollo DC Grid) |
| Bosaletse Mpesi | Secondary Plant Manager (Free State Grid) |
| Regi George | Secondary Plant Manager (Northern Cape Grid) |

9. Revisions

| Date | Rev. | Compiled By | Remarks |
|----------|------|-------------|--|
| Oct 2019 | 3 | A Majozi | Business requirement |
| Nov 2014 | 2 | A Majozi | Removed manufacturer specified product. |
| Oct 2012 | 1 | K Naicker | Removed Type 3 and Type 4 TDB Removed 400V AC Control Room AC Board Changed all MCB manufacturer type Revised Technical A/B Schedules Included 230V AC Board Included wiring specifications per board Revised all drawings Included MCB padlocking facility Included manufacturer testing requirements |

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| Date | Rev. | Compiled By | Remarks |
|----------|------|-------------|--------------------------|
| Mar 2009 | 0 | JM Mafusana | Original issued – 32-597 |

10. Development team

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

- Alpheus Majozi
- Mario Petersen
- Richard Mavuso
- Trevor Pope

11. Acknowledgements

Not applicable.

Annex A – Impact assessment

Impact assessment form to be completed for all documents.

1) Guidelines

All comments must be completed.

Motivate why items are N/A (not applicable)

Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.

Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

2) Critical points

2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

This document is necessary due to technology changes and to optimise costs.

2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

N/A

2.3 Impact on stock holding and depletion of existing stock prior to switch over.

N/A. The DB's and JB's are required only in breaker-and-a-half substations.

2.4 When will new stock be available?

December 2013

2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swap possible with a competitor's product?

The JB's and DB's are interchangeable with a competitor's product

2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

N/A

2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: (N/A during commenting phase)

3) Implementation timeframe

3.1 Time period for implementation of requirements.

N/A

3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

The JB's and DB'S are applicable to Transmission's breaker-and-a-half-substations

4) Buyers Guide and Power Office

4.1 Does the Buyers Guide or Buyers List need updating?

N/A

4.2 What Buyer's Guides or items have been created?

N/A

4.3 List all assembly drawing changes that have been revised in conjunction with this document.

The drawings of all JB's and DB's covered by this specification has been revised.

4.4 If the implementation of this document requires assessment by CAP, provide details under 5

4.5 Which Power Office packages have been created, modified or removed?

N/A

5) CAP / LAP Pre-Qualification Process related impacts

5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

N/A

5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Open enquiry for these equipment will commence in 2013.

5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

N/A

5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

N/A- Contract has expired

5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

N/A

5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Contract has expired.

5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Yes

5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

N/A

6) Training or communication

6.1 Is training required?

No

6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

N/A

6.3 State designations of personnel that will require training.

N/A

6.4 Is the training material available? Identify person responsible for the development of training material.

N/A

6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

N/A

6.6 Was Technical Training Section consulted w.r.t module development process?

N/A

6.7 State communications channels to be used to inform target audience.

N/A

7) Special tools, equipment, software

7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

N/A

7.2 Are there stock numbers available for the new equipment?

N/A

7.3 What will be the costs of these special tools, equipment, software?

8) Finances

8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

N/A

.....
.....
.....
Impact assessment completed by:

Name: Alpheus Majozi

Designation: Senior Advisor

Annex B – General Technical A/B Schedule

| Refer to this document | Description | SCHEDULE A | SCHEDULE B |
|------------------------|------------------------------------|------------|------------|
| 3 | Legal Requirements | Noted | |
| 7 | Role and Responsibilities | Noted | |
| 9. | General specification requirements | | |
| 9.1 | Construction | Comply | |
| 9.2 | Doors | Comply | |
| 9.3 | Anti-condensation heater | Comply | |
| 9.4 | Drainage | Comply | |
| 9.5 | Gland plates | Comply | |
| 9.6 | Corrosion Protection | Comply | |
| 9.7 | Damaged Paint Work | Comply | |
| 9.8 | Nuts, Bolts, Washers and Screws | Comply | |
| 9.9 | Base Frame | Comply | |
| 9.10 | Wiring | Comply | |
| 9.11 | Labels | Comply | |
| 9.12 | MCB locking brackets | Comply | |
| 9.13 | Earthing | Comply | |
| 9.14 | MCB's | Comply | |
| 10.5 | Test Certificate | Comply | |
| 11 | Packaging | Comply | |
| 12 | Transport | Comply | |
| 13 | Drawings | Comply | |

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Annex C – Specific Technical A/B Schedule for VTJB 0700

| No | Items | Schedule A | | | | Schedule B |
|-----|--|---|-----------------|--|--------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 1 | Labels | Labels are to be attached for each component, and MCB's. | | Eskom standard 240-62629353 | | |
| 2 | MCB's | | | | | |
| 2.1 | Three pole MCB's with an Auxiliary contact | (3P MCB's) x 10 + auxiliary contacts x 10 | 16A | | | |
| 2.2 | Single Pole MCB's | (1P MCB's) x 6 | 16A | | | |
| 2.3 | Double Pole MCB | (2P MCB) X 1 | 6A | | | |
| 3 | Doors | The door stay must be of hook and eye type not window stay | | To be specified by supplier for the purchaser's approval | | |
| 4 | Heater | | 30 W at 230 VAC | To be specified by supplier for the purchaser's approval | | |
| 5 | Casing/ construction | The casing must be structure mounted according to drawings 0.54/6731. Fabricated from 3CR12 with minimum thickness of 1.6 mm. The boxes shall be vermin proof and suitable for mounting outdoors. | | Supplier must comply to IP 54 rating | | |
| 6 | Packaging | The supplier must specify packaging for the purchaser's approval | | To be specified by supplier for the purchaser's approval | | |
| 7 | Wiring and cabling | Refer to Technical Specification, 9.10.1 | | | | |
| 8 | Copper Earth pad and brass bolt | (40 X 40 X 3 mm) Earth pad and brass bolt as indicated in detail 'a' of drawing | | | | |
| 9 | Gland Plates | To be manufactured from 2 mm 3CR12 stainless steel. The removable gland plate must be pre-drilled and a supplied with blanks. | | | | |

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| No | Items | Schedule A | | | | Schedule B |
|----|-----------|---|--------|---------------|------------------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 10 | Terminals | M10/10RS (x 94) | | | Entrelec or Equivalent | |
| 11 | Earth bar | Pre-drilled earthbar as shown in drawings | | | | |

Annex D – Specific Technical A/B schedule for Plug box Type BH

| No | Items | Schedule A | | | | Schedule B |
|----|---------------------------------|---|-----------------|--|--------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 1 | Labels | Labels are to be attached for each component. | | Eskom standard 240-62629353 | | |
| 2 | Plug/ Socket | A single phase switched socket outlet where the switch shall be the 16 A MCB. | 16 A at 230 VAC | To be specified by supplier for the purchaser's approval | | |
| 3 | Door | The door stay must be of hook type not window stay | | To be specified by supplier for the purchaser's approval | | |
| 4 | Casing/ construction | The casing must be structure mounted according to drawings 0.54/6735. Fabricated from 3CR12 with minimum thickness of 1.6 mm. The boxes shall be vermin proof and suitable for mounting outdoors. | | The supplier must comply with IP 54 rating | | |
| 5 | Packaging | The supplier must specify packaging for the purchaser's approval | | To be specified by supplier for the purchaser's approval | | |
| 6 | Wiring and cabling | Refer to Technical Specification, 9.10.2 | | | | |
| 7 | Copper Earth pad and brass bolt | (40 X 40 X 3 mm) Earth pad and brass bolt as indicated in detail 'a' of drawing | | | | |
| 8 | Gland Plate | To be manufactured from 2 mm , 3CR12 stainless steel. The removable gland plate must be pre-drilled and supplied with blanks. | | | | |
| 9 | MCB | 2P MCB (x 1) – Curve C | 16A | | | |
| 10 | Terminal | WFF16 (X3) | | | Wuidmuller | |
| 11 | Earth Bar | Pre-drilled earthbar as shown in drawings | | | | |

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Annex E – Specific Technical A/B schedule for 230V AC Board – Type 4

| No | Items | Schedule A | | | | Schedule B |
|-----|------------------------------|---|-----------------|---|-----------------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 1.1 | Labels (Equipment) | Labels are to be attached for each component, lights, relays, MCB's and switches, etc. | | Eskom standard 240-62629353 | | |
| 1.2 | Labels (Application Drawing) | Labels are required for all outgoing MCB's stating its destination according to Eskom Application Drawings | | | | |
| 2 | MCB's | | | Must comply to SANS 1574 | | |
| 2.1 | Control Circuit MCB | Three pole MCB (x 1). The tripping curve must be type C | 6A | | | |
| 2.2 | Incoming supply MCB | Four pole MCB (x 1), which must handle short circuit current of 10 kA, at 400VAC. The tripping curve must be type C | 63 A | | | |
| 2.3 | MCB's (1-36) | Single pole MCB (x 36). The tripping curve must be type C | 16A | | | |
| 2.4 | MCB's (37-60) | Double pole MCB (x 24) + Vigi | 16A | | | |
| 3.1 | Relays | AC Fail Relay | 250 VAC | | | |
| 3.2 | Phase Fail Relay | Phase fail relay (3 phase) | | | Electro or Equivalent | |
| 4.1 | Voltmeter | Range 0-400VAC | 400 VAC | | | |
| 4.2 | Voltage selection switch | Single phase selection | | | | |
| 5 | Plug Module | 2 x single phase switched socket outlet | 16 A at 230 VAC | Must be SANS approved | | |
| 6 | Indication Lights | Red indication lights must be used | 230 VAC | LED | | |
| 7 | Casing/ construction | The AC board to be 2 mm mild steel and must be suitable for floor mounting. The 230VAC | | To be specified by supplier for the purchaser's | | |

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| No | Items | Schedule A | | | | Schedule B |
|----|---------------------|---|--------|--|--------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| | | board must be a swing frame panel (2400 mm x 800 mm x 600 mm). The top of the panel must be completely sealed, | | approval | | |
| 8 | Packaging | The supplier must specify packaging for the purchaser's approval | | To be specified by supplier for the purchaser's approval | | |
| 9 | Wiring and cabling | Refer to Technical Specification, 9.10.5 | | | | |
| 10 | Terminals | Wuidmuller WDU and WFF as shown in Drawing 0.54/7106 sheet 7 | | | | |
| | | | | | | |
| 11 | Padlocking facility | MCB locking brackets made out of mild steel for all outgoing MCB's. | | | | |
| 12 | Gland Plate | To be constructed of 3 mm mild steel. (20 mm holes x 60) + (32 mm holes x 3) + Position of holes is shown in drawing. Bottom entry only for cables | | | | |
| 13 | Base Frame | Galvanised mild steel (100 x 50 x 3) | | | | |
| 14 | Earth Bar | Pre-drilled earthbar to be provided | | | | |

Annex F – Specific Technical A/B schedule for DC Board DMK - Type 1

| No | Items | Schedule A | | | | Schedule B |
|-----|----------------------------------|---|------------------|-----------------------------|------------------------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 1.1 | Labels (Equipment) | Labels are to be attached to both the front and rear of each component, lights, relays, MCB's and switches. | | Eskom standard 240-62629353 | | |
| 1.2 | Labels (Application Drawing) | Labels are required for all outgoing MCB's stating its destination according to Eskom Application Drawings | | | | |
| 2 | Switch (SSW) | Selector switch must handle breaking currents of 100 A, 3 pole with 3 positions and 1 position must be the off position | 100A at 220 V DC | | Comelectric or equivalent | |
| 3 | DC to DC converter | CS10.244 24VDC, 10A Output | 220/24 VDC | | PULS DIMENSION or equivalent | |
| 5 | Secure supply changeover circuit | | | | | |
| 5.1 | DU 1 | Diode units, refer to Eskom DC board DMK drawing | 220 VDC | | | |
| 5.2 | DCF (SS) | Secure supply DC fail relay, refer to Eskom DC DMK drawing | 220 VDC | | | |
| 5.3 | DCF (SSM2) | DC Fail Secure Supply Main 2 | 220 V DC | | | |
| 5.4 | SSR1 (M1) & M2 | Secure supply relays, Refer to Eskom DC board DMK drawing | 220 VDC | | | |
| 5.5 | SSR | Flip flop secure supply relay, Refer to Eskom DC board DMK drawing | 220 VDC | | | |
| 5.6 | ACF | AC fail relay, Refer to Eskom DC board DMK drawing | 230 VAC | | | |
| 5.7 | LCR | Lamp Check Relay | | | | |
| 6 | MCB's (DCI M1 & DCI M2) | Double pole DC MCB (x 2) + open/close auxiliary contact (x 1). The tripping curve must be type C | 63A | | | |
| 6.1 | MCB's | Double pole DC MCB (x 2) + | 25A | | | |

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| | | Schedule A | | | | Schedule B |
|-----|------------------------------------|---|--------------|---------------|-----------------------|------------|
| No | Items | Description | Rating | Code/Standard | Manufacturer | |
| | (DCI(SS)(M1) & (DC1(SS)(M2) | open/close auxiliary contact (x 2). The tripping curve must be type C | | | | |
| 6.2 | MCB (DCI(CONV) | Double pole DC MCB (x 1) + open/close auxiliary contact (x1). The tripping curve must be type C | 16A | | | |
| 6.3 | MCB's (220VDC SS) | Double pole DC MCB (x 5) + open/close auxiliary contact (x5). The tripping curve must be type C | 20A | | | |
| 6.4 | MCB's (24VDC SS) | Double pole DC MCB (x 5) + open/close auxiliary contact (x5). The tripping curve must be type C | 10A | | | |
| 6.5 | MCB's (220VDC Motorised Isolators) | Double pole DC MCB (x 13) + open/close auxiliary contact (x13). The tripping curve must be type C | 50A | | | |
| 6.6 | MCB's (220VDC Spring Rewind) | Double pole DC MCB (x 7) + open/close auxiliary contact (x 7). The tripping curve must be type C | 50A | | | |
| 6.7 | MCB (AC) | Double pole AC MCB (x 1) + open/close auxiliary contact (x 1). The tripping curve must be type C | 10A | | | |
| 7 | Casing/ construction | The DC board DMK to be 2 mm mild steel and must be suitable for floor mounting. The DMK DC board must be a swing frame panel. The top of the panel must be completely sealed, | | | | |
| 8 | Indication Lights | Red, indication lights must be used as in Eskom DC board DMK drawing 0.54/6730 | 220 VAC/ VDC | | | |
| 9 | Packaging | The supplier must specify packaging for the purchaser's approval | | | | |
| 10 | Wiring and cabling | Refer to Technical Specification, 9.10.3 | | | | |
| 11 | Doors | The door must be swing frame | | | | |
| 12 | Terminals | Refer to Drawing – Equipment Layout –SHT 1 | | | Wuidmuller / Entrelec | |

| | | Schedule A | | | | Schedule B |
|----|-------------|---|--------|---------------|--------------|------------|
| No | Items | Description | Rating | Code/Standard | Manufacturer | |
| 13 | Gland Plate | To be constructed of 3 mm mild steel. (20 mm holes x 15) + (32 mm holes x 24) + Position of holes is shown in drawing. Bottom entry only for cables | | | | |
| 14 | Base Frame | Galvanised mild steel (100 x 50 x 3) | | | | |
| 15 | Earth Bar | Pre-drilled earthbar to be provided | | | | |

Annex G – Specific Technical A/B schedule for AC Board DMK - Type 1

| No | Items | Schedule A | | | | Schedule B |
|-----|------------------------------|---|-----------------|--|--------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 1.1 | Labels (Equipment) | Labels are to be attached to both the front and rear of each component, lights, MCB's and switches. | | Eskom standard 240-62629353 | | |
| 1.2 | Labels (Application Drawing) | Labels are required for all outgoing MCB's stating its destination according to Eskom Application Drawings | | | | |
| 2 | MCB's | All MCB's are all rated for short circuit current of 5 kA. Type C tripping curve | | | | |
| 2.1 | MCB (40 A) | Triple pole AC MCB (x 1) + open/close auxiliary contact (x 1). The tripping curve must be type C | 40A | | | |
| 2.2 | MCB (20 A) | Double pole MCB (x 3) + Vigi (x 3) | 20A | | | |
| 2.3 | MCB (16A) | Single pole MCB (x 41) + open/close auxiliary contact (x 41). The tripping curve must be type C | 16 A | | | |
| 3 | Switches | 3P Isolator | 125 A | | | |
| 4 | Plugs/ Sockets | A single phase socket with earth leakage must be used | 16 A at 230 VAC | SANS Approved | | |
| 5 | Indication Lights | Red LED | 230 VAC | | | |
| 6 | Casing/ construction | The DMK AC board to be 2 mm mild steel and must be suitable for floor mounting. The DMK AC board must be a swing frame panel. The top of the panel must be completely sealed, | | To be specified by supplier for the purchaser's approval | | |
| 7 | Packaging | The supplier must specify packaging for the purchaser's approval | | To be specified by supplier for the purchaser's approval | | |

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| No | Items | Schedule A | | | | Schedule B |
|----|---------------------|---|---------|--|--------------|------------|
| | | Description | Rating | Code/Standard | Manufacturer | |
| 8 | Wiring and cabling | Refer to Technical Specification, 9.10.4 | | | | |
| 9 | Relay | AC fail relay, Refer to Eskom AC board DMK drawing | 230 VAC | | | |
| 10 | Door | The door must be swing frame | | To be specified by supplier for the purchaser's approval | | |
| 11 | Padlocking facility | MCB locking brackets made out of mild steel for all outgoing MCB's. | | | | |
| 12 | Gland Plate | To be constructed of 3 mm mild steel. (20 mm holes x 46) + (32 mm holes x 2) +(40 mm holes x 2) Position of holes is shown in drawing. Bottom entry only for cables | | See drawing 0.54/6729 SHT 1 | | |
| 13 | Busbars | 3 x (20 mm x 6 mm) copper busbars ,with insulators must be located at position 4.47 as indicated in the drawings. Perspex Cover is required on busbars. | | | | |
| 14 | Base Frame | Galvanised mild steel (100 x 50 x 3) | | | | |
| 15 | Earth Bar | Pre-drilled earth bar to be provided | | | | |