

MINIATURE SUBSTATION

13.1 SCOPE

- 13.1.1 This specification covers the Departments minimum requirements for the selection, manufacture, testing and supply of outdoor type miniature substations. It is applicable to medium-voltage substations for systems with AC rated nominal voltages 12 kV. This specification covers Type B miniature substations requirements not exceeding 630 kVA.
- 13.1.2 The tests prescribed in this specification will evaluate the performance capabilities of medium-voltage miniature substations.
- 13.1.3 The provisions of NRS 004 miniature substation requirements must be adhered to have been adopted, in order to ensure that quality miniature substations are purchased.

13.2 NORMATIVE REFERENCES

- 13.2.1 The following documents contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.
 - 13.2.1.1 **NRS 004 (Int) : 2000:** Mini-subst for rated A.C. Voltages up to and Including 11kV.
 - 13.2.1.2 **CP-TSSPEC-006 : 2002:** Specification for 11 kV metal-enclosed ring Main units for type B miniature substations.
 - 13.2.1.3 **NRS 068: 2002:** Cable earth fault indicators.
 - 13.2.1.4 **SABS 555: 1985:** Mineral insulating oil for transformers and switchgear (uninhibited).
 - 13.2.1.5 **NRS 053 : 2000:** Accessories for Medium Voltage power cables (3,8/6,6kV to19/33kV)
 - 13.2.1.6 **SABS 1339: 2000:** Electric cable – Crossed-link polyethylene (XLPE) - insulated cable for voltages from 3, 8/6,6kV to 19/33kV.
 - 13.2.1.7 **SABS 780 : 1998:** Distribution transformers
 - 13.2.1.8 **BS EN 50180 : 1999:** Bushings above 1 kV up to 36 kV and form 250A to 3,15kA for liquid filled transformers

13.3 GENERAL

- 13.3.1 The transformer shall be approved in writing by the Engineer.
- 13.3.2 **No refurbished miniature - substations / 2nd hand will be accepted.**
- 13.3.3 Miniature substation shall be installed, tested and commissioned to Council's standards, complete with base as described later.

- 13.3.4 Only 315kVA TYPE B or 630kVA TYPE B miniature substation shall be used.
- 13.3.5 The Mini Sub shall be complete with but not limited to the following, an 11kV Ring Main Unit with SF6 OR Vacuum breaker with self-power protection relay, a low loss wound distribution transformer, LV bus-bars, switchgear, small wiring, street light panel, contactors, Current Transformers etc.
- 13.3.6 It shall be suitable for use at an altitude of 1000m above mean sea level in an area of high summer rainfall, and high humidity with severe lightning conditions and light winter frost.
- 13.3.7 The main supply to the LV compartments shall be metered with appropriate CT's and meter as described elsewhere.
- 13.3.8 To comply with the relevant SANS specification

13.4 ENCLOSURE

- 13.4.1 The housing shall be rectangular in plan, approximately 3 meters long by 1, 2 meters wide (manufacturer's nearest standard). Colour shall be avocado code C 12.
- 13.4.2 The housing shall be of 2mm 3CR12 construction. The housing shall be erected on a rolled steel channel under base of 100 x 50mm, galvanised and Epoxy tar painted and shall be rigid, robust and completely self-supporting. All bolts and screws to be cadmium plated. The housing shall be so designed that it can be lifted off, complete with base frame, or lowered over a Ring Main Unit fixed to already connect HV cables.
- 13.4.3 The housing shall be vermin proof, dust and corrosion proof and shall protect the internal equipment from spray water or falling rain at an angel of 60 degrees to the vertical.
- 13.4.4 Adequate ventilation shall be provided to prevent the build-up of condensation or heat in any compartment, including driver of the miniature substation.
- 13.4.5 The housing shall be divided to approval into four separate compartments for HV Switchgear, transformer, LV main circuit breaker and transformer accessories, LV Switchgear, busbar and metering. The switchgear compartment: IP 66 shall be provided with an approved hinged locking access doors. These doors shall exert uniform pressure at all points on the gasket when the door is closed and shall be adequately sized for the operation and maintenance of the equipment installed therein. All doors shall open from the outside. The locking handle on each door shall be such as to accept the Council's standard substation padlocks.

13.5 CLEANING AND PAINTING

- 13.5.1 The metal shall be degreased and shot blasted to remove all dirt, scale or blemishes. It shall be powered coated in an approved fashion with one coat zinc chromate primer and two coats of scratchproof, weatherproof enamel, both on the inside and outside of the unit. The instrument/circuit breaker panel shall be painted white inside and the outside, including the roof, avocado green to SABS specification.

13.6 TRANSFORMER (TO SABS 780/1979)

- 13.6.1 The low loss transformer shall be of the indoor oil immersed type, filled with oil to SABS 555-1959, and shall be tested before the filling and dispatch of the transformer.
- 13.6.2 The winding shall be of plain annealed copper or copper foil and the connections shall be of plain annealed copper conductors adequately insulated and braced to maintain clearances between other windings and between live parts and other metal parts when subjected to short circuit or earthed conditions, and to be free of vibration in normal service and during transport.

13.7 GENERAL SPECIFICATIONS

- 13.7.1 Noise levels Shall not exceed those laid down in SABS 780
- 13.7.2 Voltage Ratio 11kV/420V/242 V – open terminal with earthed neutral
- 13.7.3 Vector group Dyn 11
- 13.7.4 Tapping`s on HV Windings $\pm 2,5\%$ and $\pm 5\%$
- 13.7.5 Tapping Adjustment , By means of externally operated, off load lockable tap switch
- 13.7.6 The transformer shall be fitted with indoor bushings and terminal adapters suitable for the number and size of connections, both HV and LV cabling.
- 13.7.7 The tank shall be of the sealed non-breathing type incorporating 20% free space above the oil.
- 13.7.8 The transformer compartment shall be removable without disturbing HT or LT cabling.

13.8 HIGH VOLTAGE EQUIPMENT

- 13.8.1 The high voltage equipment shall incorporate a Ring Main Unit rated 630A, 350 MVA for 3 seconds or similar equipment approved in writing by the Engineer, fitted with a suitable bracket with wooden clamping blocks, below terminals of switchgear, to clamp and support up to 185 mm² PILCDSTA cable for a 315 KVA and up to 185 mm² for 630 KVA and a SF6 or Vacuum breaker. The unit shall incorporate cable earthing device and cable test connections behind and interlocked safety cover.
- 13.8.2 Test certificates to BS 116 and 3941 shall be provided for each unit.
- 13.8.3 Marking of conductors and terminals of power and secondary circuit to show phase sequence shall comply with BSS 158-1968. Busbar connections and risers shall be air insulated to BSS 169-1957.
- 13.8.4 Clearance from phases to earth and between phases to BSS 162.
- 13.8.5 The Ring Main Unit shall face the housing to the front same as the LT equipment.

13.9 LOW VOLTAGE EQUIPMENT

- 13.9.1 Bus-bars connections and risers suitably colour coded, shall be air insulated and conform to the latest SABS specification or failing that, the BSS 159 shall apply. Clearances between phases and phase to earth shall be adequate and busbar

support insulators shall be of porcelain or epoxy resin moulding.

13.9.2 All connections from bus-bars shall be supported on insulators to maintain adequate spacing, and shall, like the bus-bars be of copper.

13.9.3 A LV Main Circuit Breaker 500A (3) pole **LY603 MCCB** suitably rated shall be fitted for protection between the LV transformer terminals and the LV busbar. (1000A for 630 KVA). All cable terminals shall be provided with lugs appropriate to the cable, bolts, nuts, plain washers and locknuts. This provision will be in the same compartment as the tap changer, oil purification outlets, sight glass, etc. off the transformer.

13.9.4 The main LV breaker and its terminals will be covered by a suitable, tough, venting, heat and explosive resistant clear cover.

13.9.5 Outgoing circuits shall be provided for as follows:

13.9.5.1 All terminations shall be fixed to suitable terminations. The gland plate is to be mounted to a rail to allow positioning of the gland plate as required. The rail shall be so positioned that the hole in the gland plate for the cable is in line with the terminations of the circuit breaker, and shall be mounted to the top of the under base. The rail shall be of rugged construction to allow for the secure mounting of the **gland plate**.

13.9.5.2 All gland plates shall be drilled, treated and suitably

13.9.5.3 Covered. **Four gland plates with the following hole sizes** shall be provided; 50mm diameter hole for 315 KVA and 63 mm diameter for 630 KVA. One gland plate with four 25mm diameter holes shall be provided for streetlight cables. One gland plate with one 20 mm diameter hole shall be provided for the day light switch cable.

13.9.5.4 The mounting rack for outgoing feeder circuit breakers shall be drilled for four CBI (**LN 603 and JS 150-600A**) circuit breakers.

13.9.5.5 In the metering section there shall be provision for future installation of six British Standard Footprint meters and future installation of three 10 VA current transformers for each meter shall be provided for at the busbar or below the circuit breaker on a 3CR 12 mounting plate. This shall be a hinged panel.

13.9.5.6 Streetlight equipment shall be provided for, to the right on the mounting rack mentioned: 3 x 80A 230V GEC kWh meters, AC1 contactor, **3 phase circuit breaker (150 A 20 kA)**, photocell and by-pass switch for 3ph streetlight circuit, **no fuses**.

13.10 METERING

13.10.1 All metering shall be done on the low voltage or else approved in writing by the Engineer.

13.11 CABLE TERMINATIONS & ENTRIES

13.11.1 All cable entries shall be from below and cable terminals shall be provided with lugs appropriate to the cable specified, bolts, nuts, plain washers and locknuts. These

terminals shall be located within 150mm of the cable boxes or gland plates and approved copper riser connections shall be provided between the terminals and the circuit breaker.

13.11.2 The armouring of all cables shall be earthed to the main earth busbar together with the bare copper earth conductor specified with that cable. All cables shall be terminate by means of a glad to a gland plate. This bare copper conductor shall be of the same cross section areas as the one laid with the cable and shall be connected to the earth busbar.

13.12 SOCKET OUTLET(16 AMP)

13.12.1 ONE 16 A 1 PHASE SOCKET OUTLET SHALL BE INSTALLED IN THE LV COMPARTMENT AND SHALL BE PROTECTED BY A SUITABLE CIRCUIT BREAKER AND EARTH LEAKAGE UNIT AS PRESCRIBED BY THE CODE OF PRACTICE SANS 10142-1. ALL LIVE CONNECTIONS WILL SUITABLY COVERED AS IN TERMS OF THE SAID CODE OF PRACTICE.

13.13 EARTHING IN SUBSTATION

13.13.1 An approved copper earth bar not less than 25mm x 3mm in section shall be provided along the entire length of the miniature substation internally, to which all metal parts of switchgear, transformer and cable end box glands shall be connected.

13.13.2 The earth bar shall be drilled at each end and fitted with a 10mm diameter brass terminal bolt, nut and locknut. The earth bar shall be fitted with a removable link between the HV and LV compartments.

13.14 TESTING

13.14.1 The supplier shall supply copies of all test certificates covering works tests to SABS or to the relevant BSS where not provided for by the SABS.