SPECIFICATION FOR THE SUPPLY, DELIVERY, OFFLOADING AND INSTALLATION OF MINIATURE SUBSTATIONS

REVISIONS			
REV	**DATE**	**BY**	**APPROVED**
01	**May 2023**	**L.Poswa**	**A. Tulsie**

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1. SCOPE OF WORK

1.1 This specification covers Transnet National Ports Authority's requirements for the Supply, Delivery, Offloading and Installation of coastal type Vacuum Miniature Substations for rated AC voltages up to and including 11kV or 6.6kV on the primary side and 400 V on the secondary side, and of power rating up to 1600kVA.

2. NORMATIVE REFERENCES

The following standards contain provisions that, through reference in the text, constitute provisions of this specification. At the time of publication, the editions indicated were valid. All standards are subject to revision, by applying the most recent editions of the standards listed below. Information on currently valid national and international standards may be obtained from the South African Bureau of Standards.

ASTM/E822-81 (Re-approved 1987), Standard practice for determining the resistance of solar collector covers to hail by impact with propelled ice balls (Vol. 12.02 – Nuclear (II), Solar and Geothermal Energy).

IEC 71-1: 1976, Insulation co-ordination – Part 1: Terms, definitions, principles and rules.

IEC 71-2: 1976, Insulation co-ordination – Part 2: Application guide

IEC 71-3: 1976, Insulation co-ordination – Part 3: Phase-to-phase insulation co-ordination. Principles, rules and application guide.

ISO 8501-1: 1988, Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.

NRS 005: 1990, Distribution transformers - Preferred requirements for application in the Electricity Supply Industry.

NRS 006: 1991, Switchgear – Metal –enclosed ring main units – For rated a.c voltages above 1 kV and up to and including 24kV – Preferred requirements for application in the Electricity Supply Industry.

NRS 008: 1971, Enclosures for cable terminations in air – For rated a.c voltages of 7,2 kV and up to and including 36 kV - Preferred requirements for application in the Electricity Supply Industry.

SANS 141: 1971, Glass-reinforced polyester (GRP) laminated products.
Amendment No. 3: 1979.

SANS 152: 1977, Low voltage air-break switches, air-break disconnectors, air-break switch disconnectors, and fuse-combination units.
Amendment No. 1: 1987.

SANS 156: 1977, Moulded-case circuit breakers.
Amendment No. 1: 1987.
SANS 172: 1977, Cartridge type fuse-links for low voltage electric fuses.

SANS 763: 1988, Hot-dip (galvanized) zinc coatings (other than on continuously zinc-coated sheet and wire).

SANS 780: 1979, Distribution Transformers.
Amendment No. 5: 1990.

SANS 1019: 1985, Standard voltages, currents and insulation levels for electricity supply.

SANS 1091: 1975, National colour standards for paint.
Amendment No. 2: 1989.

SANS 1186: 1978,Symbolic safety signs.
Amendment No. 7: 1990.

SANS 1195: 1978, Busbars.

SANS 1222 : 1985, Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides).
Amendment No. 1: 1989.

SANS 1473-1: 1989, Low-voltage switchgear and control gear assemblies Part 1: Requirements for type-tested and partially type tested assemblies.

SANS 064: 1979, Preparation of steel surfaces for coating.
Amendment No. 1: 1988.

SANS method 140: 1975, Dry film thickness of paints by means of a mechanical dial-indicator-type gauge.

SANS method 141: 1988, Dry film thickness of paints by means of a electro-magnetic flux or eddy current type gauges.

SANS method 147: 1975, Resistance to scratching of paint films.

SANS method 155: 1975, Resistance to salt fog of paint films.

SANS method 159: 1975, Adhesion of paint and varnish films (cross-cut test).

3. METHOD OF TENDERING

3.1 Tenderers shall submit their main offers in accordance with the requirements of this specification. Deviations from the requirements of this specification which are of a minor nature and do not depart materially, will be considered at the discretion of Transnet National Port Authority. The acceptance of alternative tenders will be considered only if a main tender is submitted as per this specification.

3.2 The "Details of Tenderer's Offer" forming Annexure 2 of this specification shall be completed in detail, for each offer. Alternative offers shall be clearly marked "Alternative Offer No. _____".

3.3 All Technical Data Sheets shall be signed by the Tenderer and returned.

3.4 All documents forming part of the Tender shall be firmly bound. No loose documents will be considered.

3.5 Failure to comply with the above requirements may preclude a tender from consideration.

4. MAIN SPECIFICATION

4.1 The specification referred to herein is NRS 004-1, Mini-substations Part 1 (latest edition).

4.2 This document must be read in conjunction with NRS 004-1, and where any conflict may occur, refer back to the Technical Officer.

5 CONSTRUCTION REQUIREMENTS

5.1 General

The mini substation shall comprise of the following:

a) a medium voltage compartment for housing the elements required from the following:
   - switch-disconnectors,
   - fuses,
   - ring main units,
   - cable terminations/boxes, and
   - cable boxes;

b) a transformer compartment having a transformer of power rating not exceeding 1600 kVA and a rated voltage not exceeding 11 kV; and

c) a low-voltage compartment with rated voltage up to and including 400 V.

The mini-substations are intended to be used under the standardized ambient conditions set out in SANS 780 for transformers on their own.

5.2 Design

5.2.1 The general arrangement of a mini-substation shall be in accordance with either the type A (in-line or longitudinal) or the type B (lateral) layout. (In the type B arrangement, the LV compartment is located on the side of the transformer, and the MV and LV compartments appear from the front to be side by side). The required layout shall be as specified in Annexure 1.

5.2.2 A mini-substation shall have a steel base of sufficient rigidity to allow the mini-substation to be lifted and clamped to its plinth without being permanently deformed or damaged.

5.2.3 The mini-substation shall have lifting lugs by which it can be lifted as a unit after the removal of the roof. After disconnection of the cables and fastenings (and removal of the roof) it shall be possible to lift the entire mini-substation from its plinth).

5.2.4 The roof shall be so designed that it does not retain water.

5.2.5 A mini-substation shall be of either the “unitary” design (see (a) below) or the “modular” design (see (b) below) as specified in Schedule 1:

a) unitary design: the compartments and transformer provided in a “unitary” design are constructed to make up a non-dismountable whole, i.e., a unit that

is not intended to be disassembled in the field to allow removal of the compartments or the transformer; or

b) modular design: the compartments provided in a "modular" design are constructed to be dismountable. The compartments shall be so designed and assembled that the transformer can be removed in its entirety without appreciable disturbance of the medium-voltage and low-voltage compartments. Conversely, the compartment housings shall be removable, after the removal of the common roof, without disturbance of the transformer, the contents of the compartments or the underground cables.

5.2.6 The enclosure shall have a degree of protection of at least IP 36 in accordance with SANS 1222, applicable when the mini-substation is completely assembled and the doors are closed.

5.2.7 Where any bolt head is accessible from outside the enclosure, it shall not be possible to loosen the bolt without having access to the inside of the mini-substation.

5.2.8 The fronts of the transformer and the medium-voltage and low-voltage compartments shall be reasonably flush.

5.2.9 Ventilation shall be by natural air circulation consistent with the enclosure specification (see 5.2.6) and power rating (see 7.2)

5.3 Materials

The roof, walls and doors of the compartments shall be (as specified in annexure 1) either

a) of metal, or

b) of glass-reinforced polyester (GRP) S 141 for type F laminated products that are resistant to accelerated weathering and resistant to prolonged contact with soil and moisture. All GRP laminated products shall carry the standardization mark appropriate to SANS 141.

5.4 Medium-voltage, low voltage and transformer compartments

5.4.1 General

The compartments shall be provided with suitable fixtures for securing all accessories supplied with the mini-substation.

5.4.2 Doors

5.4.2.1 The doors shall be large enough to allow for the installation of and access to the specified equipment, and also for the making-off of cables.

5.4.2.2 Each door shall be fitted with a robust fastening arrangement. Where specified in annexure A, this shall be three-point locking, i.e. at the top, centre and bottom via rods operated by the door handle that shall be capable of being secured by means of a padlock. If specified in annexure 1, the lock protection facility shall be provided.

5.4.2.3 Hinges, locking devices and ventilation screens shall be of a corrosion-resistant metal.

5.4.2.4 Where a gasket is necessary to achieve the required degree of protection specified (see 5.2.6), the frame of each door shall be fitted with a gasket such that, when the door is closed, sufficient pressure is exerted on the gasket to form a seal. The preferred gasket material is closed-cell expanded neoprene 25 permanently bonded with an adhesive having "tack" strength of 20 N/25 mm width.

5.4.2.5 The degree of protection shall be such that the door fasteners specified shall be capable of withstanding a force of 250 N when any part of the edge of the door is gripped by a hook subjected to a pull of such a force.

5.4.3 Strength of roof, door and wall panels

5.4.3.1 The roof shall be capable of withstanding, without permanent distortion, a mass load of 150 kg evenly distributed over an area of approximately 0,3m x 0,6m on any part of the roof.

5.4.3.2 The roof, door and wall panels shall be capable of withstanding, without damage, the hailstone impact test described in 8.3.6.

5.5 Transformers

5.5.1 The transformer shall comply with the physical and constructional requirements of SANS 780 and NRS 005 except for the following:

5.5.2 The air clearances between terminals are not required to comply with the requirements for outdoor air clearances but shall be sufficient to withstand the appropriate impulse voltages for electrically unexposed installations as set out in table 2 of SANS 1019, which for the typical rated voltages are as follows:

- 40 kV for a rated voltage of 3,6 kV;
- 60 kV for a rated voltage of 7,2 kV; and
- 75 kV for a rated voltage of 12 kV.

5.5.3 The clearance tables in NRS 008 may be regarded as a guide.

5.5.4 Accessories (including, for example, the rating plate of the off-circuit tapping switch (if provided) shall be so positioned that they are either visible or readily accessible (as relevant) when the compartment door is open.

5.6 Protection against Corrosion

5.6.1 General

5.6.1.1 Where 3CR12 material is to be used, treatment after fabrication and painting shall be in accordance with the metal supplier's specification.

5.6.1.2 Glass-reinforced polyester (GRP)

If glass-reinforced polyester is to be used it shall be protected against corrosion as follows:

The exterior coat shall be (a fire-resistant) crystic gelcoat 7256PA, pigmented to the raw material manufacturer's specification and of uniform thickness. The gelcoat shall be backed

by one layer of surface tissue.

The interior surface shall be painted. The laminate shall consist of three layers of 450 g/m² chopped strand mat bound with crystic 7256 PA or a general—purpose orthophthalic polyester resin that contains no fillers or dilutants. The resin-to-glass ratio shall be not less than 2,5:1 and not more than 3:1. The laminate shall have a uniform thickness throughout and shall have a smooth finish externally.

5.7 Bases

5.7.1 Steel bases shall be hot-dip galvanised in accordance with the relevant requirements of SANS 763 and, when specified in Annexure 1, the bases shall, in addition be coated with black epoxy tar paint.

5.8 Mini-substation (excluding base)

5.8.1 **General**
All surfaces of the mini-substation and other non-current carrying parts (including screws, nuts, bolts and washers) that are not of a material that is inherently corrosion-resistant shall be protected from corrosion by application of a suitable paint of coating system which satisfies the requirements of the tests given in 8.5

5.8.2 **Surface Preparation.**

Prior to coating, surfaces shall be free from burrs and sharp edges and shall have been prepared in accordance with SANS 064; alternatively they shall be blast-cleaned to grade SA 2½ of ISO 8501-1. Hot-dip galvanised surfaces shall be prepared for painting in accordance with the pain manufacturer's recommendations for application to this surface.

5.8.3 **Painting/coating Processes**

The painting/coating processes adopted shall conform to the paint/coating manufacturer's recommendations and shall take account of the intended conditions of use, environment and maintenance. The paint/coating finish shall be smooth, uniformly applied and free from visible defects.

5.8.4 **Colour**

All external surfaces shall be finished to the colour Orange as defined in SANS 1091.

5.8.5 **Plinths**

The characteristics of rationalised plinths (e.g. the base fixing details, the opening sizes and hence matching fixings in the mini-substation) which will accommodate the range of mini-substations covered by this specification currently being manufactured, are given in NRS 004-1.

6. DIMENSIONAL REQUIREMENTS

6.1 Transformer

6.1.1 The preferred dimensions of the transformer for a "modular" design (see 4.2.5 (b)) are given in

NRS 004-1. The intention is to provide for interchange ability between different ratings. A tolerance of +- 3mm should apply to dimensions (except in the case of the height where a range is indicated on the figure). The internal transformer body dimensions are not restricted.

6.1.2 The terminals of the transformer shall be positioned on the short sides (ends).

6.2 Compartment Dimensions

The overall dimensions of mini-substations are given in NRS 004-1 figures 1 and 2. The dimensions of the mini-substations shall be such that the base, when placed on the standardised plinths shown in NRS 004-1 figures 1 and 2 (as appropriate), will rest on the plinth without protruding or creating gaps. The sizes of the medium-voltage and low-voltage compartments are not laid down individually.

6.3 Steel Base

Steel bases shall have a height of at least 75mm.

Note – Other dimensions are not laid down, since these depend on the dimensions of the compartments used.

7. ELECTRICAL REQUIREMENTS

7.1 General

The mini-substation shall be suitable for use in a three-phase 50 Hz system of nominal voltage as specified in Annexure 1, of which, unless otherwise stated, the LV neutral will be solidly earthed. The mini-substation shall withstand a separate-source withstand voltage test (see 7.3.2) at values as set out in SANS 780 appropriate to the selected voltage rating.

7.2 Power Rating

The power rating of a mini-substation shall be one of the values given in SANS 780 within the range given in 4.1 of this specification as specified in Annexure 1. The preferred ratings is as follows:

- **XXX** kVA (as specified);

7.3 Earthing

7.3.1 The MV and LV compartments shall be provided with an earth bar of cross-sectional area equal or equivalent to that of an electrolytic copper conductor of a cross-sectional area of at least 70mm².

7.3.2 All earth connections to busbars shall be made by means of corrosion-protected M12 steel bolts, washers, spring washers and nuts.

7.3.3 Metal supports of glass-reinforced resin compartments shall be bonded together and connected to an earthing terminal.

7.3.4 For a minisub installation carried out in areas where Cathodic protection is a requirement, a

Spark Gap with a minimum Nominal discharge current of 50kA shall be installed to form isolation of earth connections.

7.4 Medium-voltage compartment

7.4.1 Equipment

7.4.1.1 The equipment to be mounted in the medium-voltage compartment shall be as specified in Annexure 1 and should if required to be supplied, normally be selected from one of the following:

a) Two MV cable boxes with cable terminations as described in 7.4.2.1 (if specified in Annexure 1, bolted current-limiting fuses shall be fitted in the tee-off connection); or
b) A ring main unit that complies with the requirements of NRS 006; or
c) A fully insulated compact switching device capable of complying with the performance requirements of NRS 006.
d) Preference will be given to low-maintenance vacuum switchgear type.
e) Manually operated fault-making, load-breaking type switchgear shall be provided.
f) Each switch unit shall have at least three lockable switching conditions i.e. "ON", "OFF" and "EARTH". Direct operation from "ON" to "EARTH" shall not be possible.
g) Test terminals for the purpose of testing the feeder cables shall be provided. Mechanical interlocking shall be provided so that access to these terminals shall only be possible with the switch in the earthed position.
h) An integral earthing device shall be provided to earth the cable side of the switch or the busbars.
i) It shall be possible to close the door to the HV compartment with the switches in the isolated or earthed position.
j) Access to fuses shall not be possible unless the associated switch is in the isolated position.
k) Fuses shall be of the H.R.C. cartridge type suitable for use on the system of supply as specified in Annexure 1, and shall be fitted with striker pins or special devices to provide single phasing protection.
l) The contractor shall supply one (2) outdoor cable termination kit, suitable for terminating the medium voltage cable as specified by the Transnet National Ports Authority representative. The termination kit shall be suitable for anti-electrolysis cables where the screen and armouring are not joined in the termination kit but can be linked if necessary.

7.4.2 Terminations for incoming cables

7.4.2.1 Where MV cable terminations are specified, the type shall be one of the following, as specified in Annexure 1:

a) Vertical-type trifurcating cable boxes suitable for the type and size of cable specified in Annexure 1 and of the type specified in Annexure 1 complete with all accessories such as terminals, plumbing glands and armour clamps and suitable for filling with semi-fluid compound; or
b) Post insulators for dry terminations in air, which comply with the requirements of NRS 008.

7.4.2.2 Where post insulators are specified, a rail for clamping the cables shall be provided.

7.4.2.3 Where ring main units are specified, the cable terminations shall be suitable for the type and size of cable specified in Annexure 1.

7.4.2.4 The gland plate of the cable, where applicable, shall always be positioned above the top of the mini-substation steel base.

7.4.3 Internal Connections

7.4.3.1 Connections between the transformer and cable terminals in the MV compartment shall be made by means of single-core cables insulated for the rated voltage of the connected equipment and having a conductor of minimum cross-sectional area 50mm² for copper material or 70mm² for aluminium. The terminals shall be shrouded or taped in an acceptable manner.

7.4.3.2 Cables that have their semi-conducting screens or copper screen tapes earthed on one side may be bunched or strapped together. Cables without earthed screens shall be separated and the clearances measured between cables and from cables to earth shall, as a minimum requirement, comply with the requirements of NRS 008 or, if the applications are not covered, with the requirements of IEC 71.

7.5 Low Voltage Compartment

7.5.1 Transformer Connections

7.5.1.1 The connection between the LV transformer bushings and the LV panel shall comprise single-core, stranded, colour-coded PVC insulated cable. The current density in each phase, including the neutral, shall not exceed 2,5 A/mm² of copper or copper-equivalent area.

7.5.1.2 Where a crimping method is to be used for terminating the ends of these connections, it shall be with long barrel-type lugs crimped by means of a correctly matched crimping tool that only releases after full compression has been employed. Arrangements which result in two lugs on top of each other on one terminal are unacceptable. Each lug shall be crimped in at least two adjacent points on the barrel.

7.5.1.3 Due allowance shall be made for short-circuit effects (such as electrodynamic forces acting on the connections) and for the avoidance of hot-spot creation due to any bracing arrangements.

7.5.1.4 Colour coding may take the form of the colour of the PVC cable itself or a coloured sleeve fitted over the lug barrel (after crimping, if applicable). The required colours are:

RED, WHITE, BLUE	-	Live phases; and
BLACK	-	Neutral

7.5.1.5 If any LV equipment is to be fitted in this compartment, the transformer connections shall be screened to prevent accidental contact.

7.5.2 LV Panel

7.5.2.1 General

The layout of the panel shall be as specified and set out in Annexure 1. When customer metering, such as kWh meters and maximum demand meters, is installed in a common compartment with power circuits, live connections shall be screened against inadvertent contact by persons (such as meter readers) requiring access.

7.5.2.2 Busbars

Busbars shall be made of hard-drawn copper and shall comply with the requirements of SANS 1195 where relevant. They shall extend the full length of the LV panel. The current density shall not exceed 1,8 A/mm² Busbars shall be untinned and bare, with neither heat shrink sleeving nor tape wrapping applied. The neutral busbar shall be dimensioned similarly to the other busbars.

Busbars shall be colour-coded according to the preferred colours of red, white, blue and black by means of a clearly visible painted-on spot of diameter at least 20 mm.

Clearance to earth and between phases shall be at least 20 mm, unless otherwise indicated in Annexure 1.

The LV panel and busbars shall be able to withstand the effects of the rated short-time current available at the terminals of the transformer.

Busbar supports, spacers and insulation systems shall be manufactured from materials whose characteristics for the purpose have been established b tests to an appropriate SANS or IEC standard.

7.5.2.3 Earth Busbar

A rectangular-section earth busbar of bare hard-drawn copper shall be provided to facilitate earthing of cable sheaths and armour. It shall have a cross-sectional area of at least 70 mm² and a minimum width of 25mm.

Centrally located holes to clear M12 bolts shall be provided at intervals of 75mm along the whole length of this earth busbar.

7.5.2.4 Gland Plates

The LV compartment shall be fitted with either a cable-clamping rail or removable individual gland plates (specified in Annexure 1), the latter being undrilled except where holes are called for in Annexure 1.

The distance from the gland plate to the top of the plinth shall be at least 75mm, and there shall be at least 350mm between the gland plate and the nearest terminals of the outgoing LV circuit.

Gland plates shall be made of corrosion-protected mild steel of thickness at least 3mm.

7.5.2.5 Feeder Circuits

Connections from the busbars to LV equipment shall be selected from

a) solid insulated conductor,
b) stranded cable, and
c) laminated busbar.

The size of the busbar or cable shall be selected to suit the current rating of the circuit and the fault rating of the transformer.

Where flexible cable is used, the connection to the busbar shall be by means of lugs. Where

crimped lugs are employed, the same requirements shall be observed as for the transformer connections (see 6.5.1). The size of this connection shall be at least equivalent to that of an electrolytic copper conductor of a cross-sectional area of 35mm².

When the specified clearance cannot be achieved, the busbars or connections shall be fully insulated.

When aluminium LV cables are used, all outgoing circuit terminations shall be compatible with this material.

All connections to the busbars shall be made by means of corrosion-resistant steel bolts, washers, spring washers and nuts.

7.5.2.6 Auxiliary Circuits

All auxiliary circuits shall be protected by either HRC fuses or moulded-case circuit-breakers (MCCBs). Auxiliary wiring should be of PVC multistrand cable of cross-sectional area of at least 2,5mm².

All auxiliary wiring shall be in accordance with a circuit diagram agreed between the parties and, if required by the purchases, numbered by means of an approved type of numbering ferrule at both ends of the wire, as specified in Annexure 1.

The insulation of the wiring and associated equipment in the low-voltage compartment shall be capable of withstanding test voltages as follows:

-300/500 V grade wiring -1 kV; and
-600/1 000 V grade wiring-2 kV.

7.5.2.7 Equipment

Particulars of equipment that shall be supplied are given in Annexure 1. The following requirements apply only where equipment is specified in Annexure 1:

a) Indicating ammeters shall be of the standard 96mm type, phase-identified without internal saturation current transformers;
b) thermal maximum demand ammeters shall have internal saturation current transformers;
c) LV fuse-links for outgoing circuits in fuse carriers shall comply with the requirements of SANS 172, for 50 kA rated breaking capacity, and shall have 82mm between fixing centres; and
d) LV switches, fuse-combination units and MCCBs shall be capable of complying with the performance requirements of the applicable of SANS 152 and SANS 156.

Note - Earth leakage protection is, in general, not required unless otherwise specified where there is local distribution section within the LV compartment of the Minisub. .

7.6 Transformer

7.6.1 The transformer shall comply with all the relevant electrical requirements of SANS 780 and

NRS 005 and, in addition, the temperature rise shall not exceed the appropriate limits specified in SANS 780 when the transformer is mounted inside the mini-substation.

7.6.2 Unless otherwise specified in Annexure 1, the rated no-load secondary voltage shall be 242/420 V.

7.6.3 If required, off-circuit tap-changers with a range of +-5% in 2,5% steps may be specified in Annexure 1. (See also 5.5.2).

8. TESTS

8.1 Component Tests

The tests specified for the components to be supplied (for example, the ring main unit, transformer, etc.) shall be carried out in accordance with the relevant component specifications as referenced.

8.2 Clearances

The clearances as specified (see the relevant clauses in NRS 008, and 7.4.3.2 and 7.5.2.2 in this part of NRS 004) shall be verified by inspection.

8.3 Type Tests

The tests need only be repeated for different ratings where the relevant characteristics are affected by the rating. For enclosures of the same dimensions, tests in accordance with 8.3.1, 8.3.5 and 8.3.6 might be expected to be independent of rating.

8.3.1 Tests To Prove Enclosure Design

The tests set out in SANS 1222 to prove compliance with the class of protection shall be performed, in particular, tests to prove protection of persons against contact with live parts inside the enclosure, and tests to prove protection of equipment against ingress of solid foreign bodies and ingress of liquid (see also 5.4.2.5). It shall not be necessary to direct water upwards when conducting the water jet test. It shall be sufficient for the mini-substation to be securely mounted on a flat surface.

The test against ingress of solid foreign bodies shall be performed while a hook is being used to grip any part of the locked doors, the hook being subjected to a pull of 250 N.

8.3.2 Voltage Withstand Test

The method given in SANS 780 for the separate-source voltage withstand test shall be used to prove the withstand voltage of the MV equipment. The test shall be carried out with the compartment doors closed for replacement by electrodes that simulate the shut doors).

8.3.3 Temperature Rise Test

The method given in SANS 780 shall be used for the whole mini-substation. The test shall be conducted with the compartment door closed and the mini-substation standing on a solid-level surface.

8.3.4 Short-Circuit Test

The short-circuit test described in 8.2.3 of SANS 1473-1 : 1989 shall be used.

8.3.5 Strength of Roof

A test to prove the strength of the roof (see 5.5.3.1) shall be performed by placing an appropriately designed weight on the roof, for one minute. No permanent distortion shall result.

8.3.6 Impact Strength of Roof, Doors and Walls

An impact strength test (see 4.4.3.2) shall be carried out that simulates the effect of hailstones. A perpendicular impact of 160 J approximating an artificial hailstone of diameter 75mm shall be used. A method similar to that described in ASTM/E822-81 is appropriate.

8.4 Routine Test

The insulation of auxiliary circuits of every assembly shall be tested by an appropriate, applied voltage test.

8.5 Tests on Painted Surfaces

8.5.1 Protection of coatings against corrosion shall be assessed using test samples subjected to the same painting procedures as the mini-substation components. The following tests shall be performed:

a) Adhesion test in accordance with SANS method 159; The cross-cutting coefficient shall be not less than 8.

b) Exposure to salt for 168 h in accordance with SANS method 155; The coated surfaces shall show no visible defects and the underlying metal shall be free from corrosion and scale.

c) Scratch resistance test in accordance with SANS method 147;

d) When a mass load of 1 kg is applied to the test needle, the scratch produced shall not penetrate to the underlying metal. The scratch shall have no jagged edges.

8.5.2 SANS method 140 or SANS method 141 may be used to verify paint thickness where this has been agreed between the parties, and specified in Annexure 1.

8.6 Tests on Glass-Reinforced Polyester Products

Test samples shall be submitted to a laboratory acceptable to the purchaser for routine tests. Tests shall prove compliance with the requirements of SANS 141.

9. MARKING/LABELLING/DOCUMENTATION

9.1 The transformer in each mini-substation shall have a rating plate, positioned in accordance with 4.5.2. In addition to complying with the requirements of SANS 780, the rating plate shall show the total mass of the mini-substation.

9.2 A safety notice or notices complying with the regulations issued in terms of Machinery and Occupational Safety Act, 1983 (Act 6 of 1983), to the design WW7 (See SANS 1186) and mounted on a square sheet of minimum size 100mm x 100mm and made

of a non-plastic durable corrosion-resistant material, shall be securely mounted either on the outside of the door of each outer compartment or in the centre of the front panel of the transformer compartment.

9.3 Any other notices, nameplates or labels required will be specified separately in Annexure 1 or supplied by the purchaser.

9.4 Documentation

9.4.1 Documentation required to be supplied with the tender is detailed in Annexure 1.

9.4.2 The following drawings shall be supplied by the supplier for approval:

9.4.2.1 drawings which shall reflect major dimensions and all components:

- general assembly;
- LV panel layout; and

9.4.2.2 any others called for in Annexure 1.

10. GUARANTEE

10.1 The contractor shall guarantee all equipment supplied for a period of 12 months after the date of installation and acceptance or 18 months from the date of delivery whichever occurs first.

10.2 The conditions for rectifying defective work shall be laid down in the General Conditions of the Contract

11. PACKAGING

The equipment shall be packed in such a manner that it will be protected during handling and transport by roads, rail or sea as applicable. The movements of instruments, meters and relays shall be protected against vibration damage during transit.

ANNEXURES

ANNEXURE 1

1. **SCOPE**

1.1 This specification covers the supply, delivery, offloading and installation of a mini substation at **XXX**

2 **GENERAL**

2.1 This specification is for the supply, testing, delivery, offloading and installation at site in **XXX**.

3 **MINISUBSTATION REQUIREMENTS**

3.1 GENERAL

3.1.1 The mini substation shall comprise of the following:

a) A medium voltage compartment for housing the elements required from the following:
- Switch-disconnectors.
- Fuses.
- The ring main unit.
- Cable terminations and
- Cable boxes.

b) A transformer compartment having a transformer of power rating of **XXX** kVA and a rated voltage of **XXX** kV; and
c) A low voltage compartment with rated voltage of **XXX** V.

3.1.2 The mini substation shall be designed for use under the standardized ambient conditions set out in SANS 780 for transformers on their own.

3.2 DESIGN

3.2.1 The general arrangement of the mini substation shall be in accordance with the Type B (lateral) layout.

3.2.2 The mini substation shall have a steel base of sufficient rigidity to allow the mini substation to be fitted and clamped to its plinth without being permanently deformed or damaged.

3.2.3 The mini-substation shall have lifting lugs by which it can be lifted as a unit after removal of the roof and disconnection of cables and fastenings.
3.2.4 The roof shall be so designed such that it does not retain water.
3.2.5 The mini substation shall be of modular design.
3.2.6 The enclosure shall have a degree of protection of at least IP 36 in accordance with SANS 1222, applicable when the mini substation is completely assembled and the doors are closed.
3.2.7 Where any bolt head is accessible from outside the enclosure, it shall not be possible to loosen the bolt without having access to the inside of the mini substations.

3.2.8 The front of the transformer, the medium-voltage and low voltage compartments shall be reasonable flush

3.2.9 Ventilation shall be by natural air circulation consistent with the enclosure specification.

3.3 MATERIAL

3.3.1 The roof, walls and doors of the compartments shall be **XXX** (constructed from **XXX**).

3.4 MEDIUM-VOLTAGE, LOW-VOLTAGE AND TRANSFORMER COMPARTMENTS

3.4.1 GENERAL

The compartments shall be provided with suitable fixtures for securing all accessories supplied with the mini substation.

3.4.2 DOORS

3.4.1.1 The doors shall be designed in accordance with clauses 5.4.2.1 to 5.4.2.5 of the main specification.

3.4.2 STRENGTH OF ROOF, DOORS AND WALL PANELS

3.4.3.1 The roof, doors and wall panels shall be designed in accordance clauses 5.4.3.1 to 5.4.3.2 of the main specification.

3.5 TRANSFORMERS

3.5.1 The transformers shall comply with the physical and constructional requirements of SANS 780 and NRS 005 except for the items detailed in clauses 5.5.1 to 5.5.2 of the main specification.

3.6 PROTECTION AGAINST CORROSSION.

3.6.1 GENERAL

3.6.1.1 The treatment for the material shall be in accordance with the suppliers' specification.

3.6.2 BASES

3.6.1.1 Steel bases shall be hot dip galvanised in accordance with the relevant requirements of SANS 763 and shall be coated with black epoxy tar paint.

3.6.3 MINI SUBSTATION (EXCLUDING BASE)

Protection against corrosion for the mini substations shall be in accordance with clause 5.6.4.1 to 5.6.4.2 in the general specification.

3.6.4 COLOUR

3.6.4.1 All external surface finishes shall be finished to colour Orange as defined in SANS 1091.

4 DIMENSIONAL REQUIREMENTS

4.1 Transformer

4.1.1 All dimensions shall be in accordance with clause 6.1 to 6.3 of the general specification.

5. ELECTRICAL REQUIREMENTS

5.1 The mini-substations shall be suitable for use in a three-phase 50 Hz system of nominal voltage of **XXX** kV.
5.2 The low voltage neutral shall be solidly earthed.
5.3 The power rating of the min- substation shall be **XXX** kVA.
5.4 The MV and LV compartments shall be provided with an earth bar of cross-sectional area equal or equivalent to that of an electrolytic copper conductor of a cross-sectional area of at least **XXX** mm^2.
5.5 All earth connections to busbars shall be made by means of corrosion protected M12 steel bolts, washers, spring washers and nuts.

5.6 MEDIUM VOLTAGE EQUIPMENT

5.6.1 **Equipment**

5.6.2 **Termination for incoming cables**

5.6.3 **Internal Connection**

5.7 LOW VOLTAGE COMPARTMENT

5.7.1 **Transformer Connection**

5.7.2 **Low Voltage Panel**

5.7.2.1 **General**

5.7.2.2 **Busbars**

5.7.2.3 Gland Plates

5.7.2.3.1 The LV compartment shall be fitted with a cable-clamping rail.
5.7.2.3.2 The distance between the gland plate to the top of the plinth shall be at least 75mm, and there shall be at least 350mm between the gland plate and the nearest terminal of the outgoing LV circuit.

5.7.2.4 Feeder Circuits

5.7.2.4.1 The connection from the busbar to the LV equipment shall use laminated busbars.
5.7.2.4.2 The size of the busbar shall be selected to suit the current rating of the circuit and the fault rating of the transformer.
5.7.2.4.3 Where the specified clearance cannot be achieved, the busbar or connections shall be fully insulated.
5.7.2.4.4 All connections to the busbar shall be made by means of corrosion resistant steel bolt, washers, spring washers and nuts.

5.7.2.6 **Auxiliary wiring**

5.7.2.6.1 All auxiliary circuits shall be in accordance with clause 7.5.2.6 of the general technical specification.

5.7.2.7 **Equipment**

5.7.2.7.1 Three maximum demand ammeters shall be supplied with the mini-substation. The indicating ammeters shall be as specified in clause 7.5.2.7 of the general technical specification

5.7.2.7.2 Three current transformers for the abovementioned ammeters shall be supplied with the mini-substation.

5.7.2.7.3 All low voltage fuse-links and MCCB's shall be in accordance to clause 7.5.2.7 of the general technical specification.

5.8 **Transformers**

5.8.1 The transformers shall be in accordance to clause 7.6 of the general technical specification.

6 **TESTS**

6.1 The tests for the components to be supplied shall be carried out in accordance with clause 8 of the general technical specification.

7 **MARKING/LABELLING/DOCUMENTATION**

7.1 All markings/Labelling and documentation shall be done in accordance with clause 9 of the general technical specification.

8 **GUARANTEE**

8.1 The contractor shall guarantee all equipment supplied for a period of 12 months after the date of installation and acceptance or 18 months from the date of delivery which ever occurs first.

8.2 The conditions for rectifying defective work shall be laid down in the General Conditions of Contract.

SIGNATURE OF TENDERER _____

DATE _____

ANNEXURE 2

DETAILS OF TENDERER'S OFFER

B.1.1	Type of mini-substation	
B.1.2	Total mass of mini-substation (kg)	
B.1.3	Manufacturer's name	
B.1.4	Overall Dimensions (mm)	
	With all doors closed	
	- Length	
	- Width	
	- Height	
	With all doors open	
	- Length	
	- Width	
	- Height	
B.1.5	Is provision made for lifting the complete mini-substation without dismantling?	
B.1.6	Details of corrosion protection of 3CR12	
B.1.7	Details of MV cable terminations	
B.1.8	Details of MV fuse	
	- Manufacturer	
	- Current rating	
	- Breaking capacity	
B.1.9	Busbar rating (A)	
B.1.10	Busbar insulation	
B.1.11	Make of MV switchgear	
B.1.12	Model No. of MV switchgear	
B.1.13	Make of main MCB	
	- Breaking capacity (kA)	
B.1.14	Make of other MCB's	
	- Breaking capacity (kA)	

ANNEXURE 3

STATEMENT OF COMPLIANCE
(TO BE COMPLETED BY TENDERER)

This tender complies with specification TPD-008-MINISUBSPEC in all respects.

SIGNATURE : _____ DATE : _____

This tender complies generally with specification TPD-008-MINISUBSPEC but differs from it on the following points.

_____

_____

_____

_____

_____

SIGNATURE : _____ DATE : _____

TRANSNET NATIONAL PORTS AUTHORITY
PORT OF DURBAN