# **PROJECT SPECIFICATION**

#  Standards and Regulations

The following Standards and Specifications shall be applicable:

The contractor shall source all other applicable standards and specifications such as SANS, NRS etc. as these are controlled documents. Annexures in some of the specifications are also omitted which do not have any relevance or may be conflicting to the project specification.

**Table 1:** Standards and Regulations

| **No.** | **Reference** | **Description** |
| --- | --- | --- |
| **South African National Standards** |
| 1 | SABS 0100 | Structural use of concrete |
| 2 | SABS 0144 | Detailing of steel reinforcement for concrete |
| 3 | SABS 053 | Mineral Lubricating Oil |
| 4 | SABS 1024 | Welded steel fabric for concrete reinforcement |
| 5 | SABS 1083 | Aggregates from natural sources |
| 6 | SABS 109: 1975 Amendment No 2: 1989. | National colour standards for paint. |
| 7 | SABS 1200 A | Civil Engineering Construction: General |
| 8 | SABS 1200 AA | Civil Engineering Construction: General (Small Works) |
| 9 | SABS 1200 AH | Civil Engineering Construction: General (Structural) |
| 10 | SABS 1200 C | Civil Engineering Construction: Site Clearance |
| 11 | SABS 1200 D | Civil Engineering Construction: Earthworks |
| 12 | SABS 1200 DA | Civil Engineering Construction: Earthworks (Small Works) |
| 13 | SABS 1200 DB | Civil Engineering Construction: Earthworks (Pipe trenches) |
| 14 | SABS 1200 DK | Civil Engineering Construction: Gabions and pitching |
| 15 | SABS 1200 HC | Civil Engineering Construction: Corrosion protection of structural steelwork |
| 16 | SABS 1200 LB | Civil Engineering Construction: Bedding (Pipes) |
| 17 | SABS 150, SABS 1507 | PVC Insulated Electric Cables |
| 18 | SABS 177 | Insulators |
| 19 | SABS 455 | Covered electrodes for the manual arc welding of carbon and carbon manganese steels |
| 20 | SABS 471 | Portland cement (ordinary, rapid hardening and sulphate resisting) |
| 21 | SABS 555, IEC 296 | Insulating Oil |
| 22 | SABS 626 | Portland blast furnace cement |
| 23 | SABS 763 | Galvanising |
| 24 | SABS 82 | Bending dimensions of bars for concrete reinforcement |
| 24 | SABS 831 | Portland cement 15 and rapid hardening cement 15 |
| 26 | SANS 10044-4 | Welding Part 4: The fusion welding of steel (including stainless steel): Tests for the approval of welders working to approved welding procedures |
| 27 | SANS 10100-1 | The structural use of concrete Part 1: Design  |
| 28 | SANS 10100-2 | The structural use of concrete Part 2: Materials and execution of work |
| 29 | SANS 10142-1  | The wiring of premises Part 1: Low-voltage installations  |
| 30 | SANS 10142-2  | Part 2: Medium-voltage installations above 1 kV a.c. not exceeding 22 kV a.c. and up to and including 3 000 kW installed capacity |
| 31 | SANS 10400 | The application of the National Building Regulations  |
| 32 | SANS 1186-1 | Symbolic safety signs Part 1: Standard signs and general requirements |
| 33 | SANS 1200 A | Standardized specification for civil engineering construction Section A: General |
| 34 | SANS 1491-1 | Portland cement extenders Part 1: Ground granulated blast- furnace slag |
| 35 | SANS 1491-2 | Portland cement extenders Part 2: Fly ash  |
| 36 | SANS 1491-3 | Portland cement extenders Part 3: Silica fume  |
| 37 | SANS 1700-2-3 | Fasteners Part 2: Screw threads Section 3: ISO general purpose metric screw threads - Selected sizes for screws, bolts and nuts |
| 38 | SANS 274 | Quality management systems - Guidelines for quality management in projects |
| 39 | SANS 5861-2 | Concrete tests - Sampling of freshly mixed concrete |
| 40 | SANS 5862-1 | Concrete tests - Consistence of freshly mixed concrete - Slump test |
| 41 | SANS 5862-2 | Concrete tests - Consistence of freshly mixed concrete - Flow test  |
| 42 | SANS 5862-3 | Concrete tests - Consistence of freshly mixed concrete - Vebe test |
| 43 | SANS 5862-4 | Concrete tests - Consistence of freshly mixed concrete - Compacting factor and compaction index |
| 44 | SANS 61024-1 | Protection of structures against lightning Part 1: General principles |
| 45 | SANS 61230 [Equivalent to IEC] | Live working Portable equipment for earthing and short-circuiting. |
| 46 | SANS 6156  | Water requirement of Portland cement extenders  |
| 47 | SANS 6157 | Fineness of cement and Portland cement extenders (45 µm sieve method) |
| 48 | SANS 6250 | Concrete tests - Density of compacted freshly mixed concrete  |
| 49 | SANS 6252 | Concrete tests - Air content of freshly mixed concrete - Pressure method |
| 50 | SANS 6253 | Concrete tests - Tensile splitting strength of concrete  |
| 51 | SANS 675 | Zinc-coated fencing wire (plain and barbed) |
| 52 | SANS 677 | Concrete non-pressure pipes  |
| 53 | SANS 920 | Steel bars for concrete reinforcement |
| 54 | SANS 986 | Pre-cast reinforced concrete culverts |
|   |
| **NRS & General National Standards and Acts** |
| 55 | NRS 003-1:1994 | Marking of small wiring |
| 56 | Act no. 122 | Forest Act. |
| 57 | Act no. 31 | Fencing Act. |
| 58 | Act no. 43 | Conservation of Agricultural Resources Act. |
| 59 | Act no. 63 | Mountain Catchment areas act. |
| 60 | Act no. 73 | Environmental Conservation act. |
| 61 | Act no. 85 | Occupational health and safety act. |
| 62 | AWS D1.1 | Structural welding code – Steel |
| 63 | CSRA | Standard Specifications for Road and bridge works |
| 64 | NRS 002 | Graphical symbols for electrical diagrams. Amendment 1: Index, architectural and reticulation symbols. |
| 65 | NWP 3109 | Standard drawing practice |
| 66 | SAISC | South African Steel Construction Handbook |
| 67 | TMH1 | Standard methods of testing road construction materials |
| 68 | TRH14 | Guidelines for road construction materials |
| 69 | TRH4 | Structural Design of interurban and rural road pavements |

# **Medium Voltage Cables requirements**

###  General

* Construction - the cores shall be individually screened.
* Core identification - The cores of 3-core cables shall be identified by the numbers 1, 2 and 3 printed at frequent intervals on the outer layer of paper tape. The colouring agent used for printing shall not fade unduly, shall be chemically neutral and shall have no deleterious effect on the fibres of the paper.
* Outer sheath - The outer sheath shall be black PE type PS2.
* Tests - Shall comply with the requirements of NRS 013.
* MARKING, LABELING AND PACKAGING - Shall comply with the requirements of NRS 013.
* Documentation complying with the requirements of NRS 013 shall be submitted in a catalogue format.
* 185mm², 3-core, Cu, 6.35/11kV, XLPE, Type A cable:
	+ - * Insulation: XLPE insulated, copper tape screened, PVC bedded, galvanised steel wire armoured and PVC sheathed
			* Cable mass: 12.775kg/m
			* Cable diameter: 72.8mm
			* Current rating (ground): 410A (not de-rated) (410A @ 11kV = 7.802MVA)
* 95mm², 3-core, Cu, 6.35/11kV, XLPE, Type A cable:
	+ - * Insulation: XLPE insulated, copper tape screened, PVC bedded, galvanised steel wire armoured and PVC sheathed
			* Cable mass: 8.170kg/m
			* Cable diameter: 60.5mm
			* Current rating (ground): 290A (not de-rated) (290A @ 11kV = 5.518MVA)
* 70mm², 3-core, Cu, 6.35/11kV, XLPE, Type A cable:
	+ - * Insulation: XLPE insulated, copper tape screened, PVC bedded, galvanised steel wire armoured and PVC sheathed
			* Cable mass: 6.995kg/m
			* Cable diameter: 56.3mm
			* Current rating (ground): 240A (not de-rated) (240A @ 11kV = 4.567MVA)

### Medium Voltage Cable Installation Specification





# **Cable Drum Trailer**

Cable drum trailer including complete cable handling equipment such as cable laying rollers, cable pulling socks, swivels and cable drum jacks shall be require ensuring that the cable is installed safely without damages.

# **FIBRE OPTIC CABLE**

* New Fibre optic cable shall be installed between the existing Emfuleni Vesco substation and the New VUT Switching substation to cater for Differential protection of the bulk supply cables.
* The Fibre Optic cable shall be installed in a single mode heavy duty duct installed together with medium voltage cable.
* Splicing kits shall be required for jointing the optical fibre cable in manholes
* Permanently pre-lubricated HDPE duct for fibre optic cables (Nextube's Optex or equal) (to be installed in same trench as MV cable and laid in between MV cables).
* Manholes, with tamper proof concrete covers (must be able to withstand vehicular traffic) (exact quantity to be established by contractor on site) (600x600x1200D)
* Pilot cable (for differential protection, to be installed inside substations between Vesco Substation and end user panels)

# **Road Crossing**

Where bulk supply cables cross main road, horizontal drilling shall be employed, typically 40m across the road for installation of 4 x 160mm diameter sleeves

# **Medium Voltage Switchgear Specification**

The client has standardized on the following medium voltage switchgear for their new installations.

###  Medium Voltage Switchgear Electrical Parameters

**Table 2:** Preferred Medium Voltage Switchgear Electrical Parameters

|  |
| --- |
| **Tamco Switchgear**  |
| Rate Voltage | 12kV |
| Rated insulation level - Impulse | 95kVp |
| Rated insulation level - 1min p.f. | 38kVrms |
| Rated frequency | 50/60Hz |
| Rated Normal Current | 1250A |
| Rated Short Time Current | 12kA |
| Rated Short Circuit Duration | 3s |
| Rated Short Circuit Breaking Current | 25kA |
| Rated Short Circuit Making Current | 63kAp |
| Rated Operating Sequence | 0-0.3s - CO - 3min - CO |
| Rated Closing Coil Voltage | 100/110V DC |
| Rated Trip Coil Voltage | 100/110V DC |
| Rated Motor Supply Voltage | 100/110V DC |

###  Medium Voltage Switchgear Requirements

Table 3: Switchgear requirements

|  |  |  |
| --- | --- | --- |
| **Item** | **Description** | **Requirements** |
| **1.****1.1****1.2****2.****2.1**2.1.12.1.22.1.3**2.2**2.2.1**2.3**2.3.1**2.4**2.4.1.12.4.2.22.4.3.32.4.4.4 | **Service conditions****General**a) Ambient air temperature (average) °Cb) Altitude m c) Average humidity %d) Wind pressure Pa e) Level of pollution to which equipmentwill be subjected (i.e. light, heavy or veryheavy)f) Lightning conditions**When erection is required**a) Access to siteb) To be offloaded from transport by supplier?c) Crane available for offloading?d) Distance from off-loading point to m operating positione) Nature of ground to be traversedf) Rise to fall m g) Erection prepared steel supportstructuresh) Construction power supply available if Vacapplicable**Circuit-breaker/enclosure****General**Rating plate positionHeater to manufacturer’s recommendationInternational protection rating**Assembly**Colour**Earthing**Copper earth-strap (rectangular *SABS - 0198 Part 3*)**Current transformers**Shorting – facility on the terminal blocks(protection and metering circuits)Secondary winding circuits wired to terminal stripsCT ratio selection locationCT type | -5 to +401 80095700MediumYesRoadYesNo300Soft earth3YesFront of breakerYesIP55G29 Light grey xxxxxxxYesYesMechanism box, CTterminalsRing type |

|  |  |  |
| --- | --- | --- |
| **Item** | **Description** | **Requirements** |
| **2.5**2.5.12.5.2**2.6**2.6.12.6.22.6.32.6.4**2.7**2.7.12.7.22.7.32.7.42.7.52.7.6**2.8**2.8.12.8.22.8.32.8.4**2.9**2.9.12.9.22.9.32.9.42.9.52.9.6 | **Operation & function** Type of arc control method Number of poles**Status indication** Location of indicators Breaker Open/ClosedMechanism charged/dischargedTrip counter**Operating mechanism**Mechanical Open, Close & TripCharge method for closing device (spring) Spring-charge motor ratingsDC Supply voltage VdcDC real power (max.) kWTrip-free breaker operationLock-out on SF6 pressure failureBreaker close anti-pump**Coil devices**Range of operation (as applicable)DC supply voltage % Ratings for continuous operationDC supply voltage VdcDC real power (max.) kWTrip coils required QtyClose coils required Qty**Auxiliary contacts/facilities**Duty ratingDC supply current A DC supply voltage VdcN/O & N/C contact reference positionsAlarm SF6 contacts. (if applicable) N/O N/CLockout – SF6 contacts (if applicable) N/O N/CBreaker auxiliary ‘a’ and ‘b’ contacts N/O N/CSpring-limit-switch contacts N/ON/C | SF6 or vacuum3Front on breaker Mechanical Mechanical MechanicalYesMotor and hand |
| 110 |
| Yes Yes70 to 1101101,52× trip coils1(Spare for use, mechanically operated)10110Circuit-breaker open,spring discharged, SF6 low. All auxiliary relays de-energised.02024413 |

|  |  |  |
| --- | --- | --- |
| **Item** | **Description** | **Requirements** |
| **3.****3.1**3.1.13.1.23.1.33.1.43.1.5**3.2**3.2.13.2.23.2.3**3.3**3.3.1**3.4**3.4.13.4.23.4.33.4.4 | **Control ancillaries****Control cabling**Cross-sectional areaControl wires mm2CT wires mm2Minimum number of strandsColourEarth wiresAll other wiresCT wiringScreening in main circuit compartmentsInsulated gland plates – cable screens**Terminal strip** Terminal strip position Access to terminal stripContacts/facilities wired to individual(grouped together) terminals. Breaker auxiliary ‘a’ and ‘b’ contactsSpring-limit-switch contactsBreaker control trip Breaker control close Lockout – SF6 contacts Alarm SF6 contactsCT secondary circuitsMotor circuitsHeater circuits**Contact rating**DC category duty rating A Vdc**Termination**Spare terminals (of types used in 3.4.5) % Standard wire numberingLugs (hook blade)Earth sliding link type/equivalent | 1,52,5multi-strandedgreen & yellow greyblack N/A N/AFront Unobstructed/free access at all timesYes Yes Yes Yes No Yes Yes Yes Yes1011010As per specCrimped Weidmuller TVP  |

|  |  |  |
| --- | --- | --- |
| **Item** | **Description** | **Requirements** |
| **4.****4.1**4.1.14.1.2**4.2**4.2.14.2.24.2.3**4.3**4.3.14.3.24.3.34.3.44.3.54.3.64.3.74.3.8**5****5.1**5.1.15.1.25.1.35.1.45.1.55.1.65.1.75.1.85.1.95.1.105.1.115.1.125.1.13 | **Miscellaneous****General**Guarantee periodRequired period for spares years**Accessories in cabinet**Charging and closing handles SetsSpecial and custom toolsSpares for routine maintenance**Documentation** (to be submitted with tender)Type test certificates Sets General arrangement as-built drawing Sets Schematic & wiring diagrams Sets Replacement part lists Sets Operation & maintenance manuals Sets Units used in Republic of South AfricaProject reference list, services to MunicipalitySpares lists, if applicable**Power system****Circuit-breaker rating**Nominal voltage (Un) kV Maximum (Rated) system voltage (Ur) kVRated short-time withstand current duration(tk) S Rated normal current (Ir) A System frequency Hz System voltage range pu System earthing (non-effective)Rated insulation level kVPEAK Rated short-duration power frequency kVRMS withstand voltage [50 Hz:1 min]Rated short-time withstand breaking current(Ik) kARMSRated peak withstand making current (Ip) kAPEAKBreaker bushingStandard values of transient recovery voltage related to the rated short-time withstand breaking current. See table 1A and 1B of IEC62271-100. | 101 11111YesIn Tender/Offer111123630500,9 to 1,1Non-effective9528256320 mm/kV |
| 5.1.14 | Operating duty cycle where | O-t-CO-t’-CO |
|  | t = 0,3 s |  |
|  | t’ = 3 min |  |
|  | Cooling time before duty is repeated |  |
| 5.1.15 | Number of phases | 3 |

# **MV/LV Type-B Miniature Substation Specification**

The following are the standard sizes of miniature substation to be used during construction.

### Miniature Substation Electrical Parameters

**Table 4:** Type-B 500kVA Miniature Substation Electrical Parameters

|  |  |  |
| --- | --- | --- |
| **No.** | **Description** | **Requirements** |
| 1 | Transformer kVA rating for the Type B mini-sub  | 500 |
| 2 | MV nominal voltage  | 11 kV single ratio |
| 3 | The rated voltage  | 12 kV |
| 4 | Rated LV no-load voltage  | 415 V |
| 5 | Main MCCB Adjustability Range  | 800 A – 1250 A |
| 6 | LV busbar current rating (A) | 722 A |
| 7 | Primary Rated lightning impulse withstand voltage (BIL) kV (peak) | 95 kV |
| 8 | Secondary Rated lightning impulse withstand voltage (BIL) kV (peak) | 30 kV |
| 9 | Primary Rated short-duration power frequency withstands r.m.s. voltage (kV r.m.s. – 1 min) | 28 |
| 10 | Secondary Rated short-duration power frequency withstands r.m.s. voltage (kV r.m.s. – 1 min) | 1s |
| 11 | Off-load tap-changer 11 kV range | ± 6 % with incremental steps of 3 % |
| 12 | Vector group  | Dyn11` |

**Table 5:** Type-B 600kVA Miniature Substation Electrical Parameters

|  |  |  |
| --- | --- | --- |
| **No.** | **Description** | **Requirements** |
| 1 | Transformer kVA rating for the Type B mini-sub  | 600 |
| 2 | MV nominal voltage  | 11 kV single ratio |
| 3 | The rated voltage  | 12 kV |
| 4 | Rated LV no-load voltage  | 415 V |
| 5 | Main MCCB Adjustability Range  | 900 A – 1250 A |
| 6 | LV busbar current rating (A) | 867 A |
| 7 | Primary Rated lightning impulse withstand voltage (BIL) kV (peak) | 95 kV |
| 8 | Secondary Rated lightning impulse withstand voltage (BIL) kV (peak) | 30 kV |
| 9 | Primary Rated short-duration power frequency withstands r.m.s. voltage (kV r.m.s. – 1 min) | 28 |
| 10 | Secondary Rated short-duration power frequency withstands r.m.s. voltage (kV r.m.s. – 1 min) | 1s |
| 11 | Off-load tap-changer 11 kV range | ± 6 % with incremental steps of 3 % |
| 12 | Vector group  | Dyn11 |

### General Requirements

The mini sub shall be suitable for outdoor purposes and comply with the requirement for inland condition.

### Descriptions

The mini sub shall consist of three compartments i.e.:

* Mediumh voltage switchgear compartment
* Transformer compartment
* Low Voltage switchgear compartment

All live terminals shall be tamper proof. The LV compartment shall consist of 2 sections ie:

* The front section containing meter, busbars, circuit breakers and cable gland plate.
* The side section making provision for streetlight equipment and cables.

Access to the HV and LV compartments shall only be possible by unlocking the doors. The miniature substation shall be constructed of 3 CR 12 sheet metal. The final colour finish shall be in SABS C12 “Advocado” green.

An earth bar of nominal cross section area of 70mm minimum shall be fitted inside the mini sub extending across the length of each of the medium voltage transformer and low voltage compartments.

The following notices shall be riveted onto the outside of the miniature substation:

* Danger sign in accordance with figure 3 of SABS1029 with in addition the word “Ingozi” below the word “Danger” to be fitted in front of the transformer compartment.
* The letters HV/S on the door of the medium voltage compartment.
* The letters LV/S on the door of the low voltage compartment.
* The word street lighting on the door of the street lighting panel.
* Lifting lugs suitable for hoisting the complete Mini sub shall be provided concerted under the removable roof.
* All ventilation openings shall have a deflecting plate and shall be suitable “vermin proof”.

### Medium Voltage Compartment

* The ring switches shall have a continuous rating of 630 Amp. A fault making of 250 MVA of 11 kV and withstand a fault current of 25 kA for 3 seconds.
* Each unit shall be supplied with appropriate labels to indicate the circuits.
* Switchgear shall be supplied with cable end boxes suitable for XLPE cables. Cable boxes to be earthed to main earth bar.

### Transformer in Transformer Compartment.

* Three phase double wound transformer with laminated core to SABS 780.
* The load will consist of resistive and inductive circuits.
* The no-load voltage is 11000/420 volt.
* DYN 11 Vector group.
* 50 Hz Frequency
* Supplied with and external operated off-load tap change to alter the secondary voltage in 5 steps from 95% - 105%. The tap changer shall be insulated for line voltage between tappings and provision shall be made to eliminate unintentional operation of the tap changer. The tap change switch shall be housed in the low voltage compartment in an accessible position.
* Hermetically sealed.
* The neutral shall be coupled to the earth bar directly.
* The three primary bushes shall be suitable for the use in a mini sub.
* The four secondary isolating bushes shall be suitable for the use in a mini sub.
* Type ONAN COOLING.

### Low Voltage compartment

* The busbars shall be sized for a range of mini substation indicated in this document and marked in the three phase colours i.e.: Red, Yellow and Blue.
* The neutral busbar shall have the same cross-sectional area as the phase busbars.
* The fault capacity of the busbars, circuit breakers and other equipment are determined by the impedance of the transformer ie: 25 KA.
* The front section of the LV compartment shall house the following equipment:
* One 400V, 5A Ennermax Electronic meter with maximum mass memory, manufactured by Strike Technologies with test certificate - Programming will be done by Council.
* One 25 kA MCB rated at full load current of miniature substation.
* Mounting space must be provided for at least five LY603 25 kA HY-MAG circuit breakers to be fitted next to each other with sufficient working space in between. These breakers must be supplied from busbars mounted above them.
* It shall be fitted with a cable-clamping rail over the whole length of terminations of the outgoing cables complete with clamps for minimum 95mm x 4 core cable.
* The distance from the rail to the top of the plinth shall be at least 75mm and not less than 350mm between the rail and the nearest terminals of the outgoing LV circuits.
* Earth busbar of bare hard-drawn copper shall be provided to facilitate earthing of cable amour and at least a cross - sectional are of 70mm and minimum width of 25mm. Centrally located holes to clear M12 bolts shall be provided at intervals of 75mm along the whole length.
* Low Voltage terminations shall be suitable for Aluminium out-going circuits.

### LV Compartment for Street-lighting

The side section of the LV compartment for street-lighting shall provide for the following equipment:

* 1 x 60 Amp 25 kA breaker (MCCB)
* 1 x 5 Amp MCCB for protection of the contactor coil.
* 1 x 10 Amp isolator as a “bypass” for the photocell.
* 2 x 10 Amp for lighting feeders
* 3 x Single phase kWh meters.
* 1 x 60 Amp triple pole contactor with 220V coil.
* Cable gland plate to terminate the outgoing cables.
* 1 x 20 Amp photocell mounted inside the compartment behind a suitable perspex window.