

ELECTRICAL ENGINEERING SCOPE OF WORKS

SOUTH AFRICAN REVENUE SERVICE – LEHAE LA SARS MINISUBSTATION REPLACEMENT

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Contents

1. INTRODUCTION	5
2. OBJECTIVE	5
3. ELECTRICAL SCOPE OF WORKS	5
4. SPECIFICATIONS AND REQUIREMENTS.....	6

1. INTRODUCTION

Le Hae La SARS is one of the head office precincts utilised by South African Revenue Service (SARS) located in Brooklyn, Pretoria. This office park consists of eight (8) multiple storey building blocks housing offices as well as a data centre. Two 800kVA miniature substations (mini-sub) at the Le Hae La SARS office park supply power to seven (7) building blocks. Min-sub 2 supplies Blocks A, B, and F whilst mini-sub 1 supplies Blocks C, D, G, and H.

The mini-sub has been in operation for more than 20 years. The nature of defects experienced recently on these mini-sub is indicative of the fact that they have now reached the end of their useful life. The repair costs, at a time, are in the region of 60% of the cost of installing a new mini-sub. It is for these reasons that South African Revenue Service (SARS) has taken a decision to replace the mini-sub.

Availability of reliable and continuous power supply to Le Hae La SARS is crucial for business operations. It is of utmost importance for the mini-sub to be replaced before any catastrophic failure, which would interrupt business operations, occurs.

2. OBJECTIVE

The objective of this document is to detail the technical specifications, requirements, and to highlight the scope of works for the replacement of the miniature substations.

3. ELECTRICAL SCOPE OF WORKS

The high level scope of works for this project includes, as a minimum, the following;

- Perform an as-built installation assessment, such as
 - detailed assessment of the mini-substation arrangement
 - component size measurements, particularly in the LV (low voltage) compartment
 - assess any site constraints, the mini-sub is installed in a basement parking where the use of cranes may be difficult

- measurements of the existing plinths, it is SARS' requirement that the existing plinths be used
- Development of all workshop drawings which shall be submitted to SARS for approval prior to purchase
- Performance of factory acceptance tests (FAT) which shall be witnessed by a SARS representative
- Decommissioning of the existing mini-substations and their respective LV components (circuit breakers) and transportation off site for scrapping. SARS would consider selling the decommissioned miniature substations to the appointed service provider (or others) at their book-value at the time of sale
- Transportation and installation of the new mini-substations, including all cable connections and associated breakers connections. It is a requirement for the existing cabling arrangement to be used as-is
- Testing and commissioning of the new mini-substations, including load balancing
- All warranties, user manuals, and all relevant documentation must be supplied to SARS by the service provider
- Any compliance tests and certificates, if necessary, shall be made available to SARS by the service provider
- SARS has issued out a bill of quantities (BOQ) for the works, however, the responsibility rests with the prospective service provider to ensure accuracy of details during the site briefing, as well as any other costs not catered for on the BOQ, the latter should be factored into the service provider's pricing

All electrical works shall be done according to the latest amendment of the relevant SANS and international standards to ensure compliance to safety regulations as per the OHS Act (85 of 1993).

4. SPECIFICATIONS AND REQUIREMENTS

4.1 Site Information

The following are specifications for the existing miniature substations installed at Le Hae La SARS. It is a requirement that the new mini-substations be similar in specifications to the existing

mini-subs in order to ensure that the cable sizes and arrangement remains the same, as well as the use of the existing plinths. If it is economically and technically feasible to change any specifications, this shall be presented to SARS for approval. For example, if an SF6 RMU (ring main unit) can be used instead of an oil-filled RMU.

LABELLED / NAME		MINI-SUB 1	MINI-SUB 2
	LOCATION		
SWITCHGEAR	MS / RMU / T3	MINI-SUB	MINI-SUB
	DESIGNATION	MAIN SUB	BLOCK E
	DESIGNATION	MINI-SUB 2	MINI-SUB 1
	DESIGNATION	TRANSFORMER	TRANSFORMER
	MAKE	G.E.C.	G.E.C.
	TYPE	K3AF	K3AF
	SWITCH TYPE	RMU	RMU
	SERIAL No.	98/03052	99/03688
	INSULATION TYPE	OIL	OIL
	OIL CAPACITY	100L	100L
	YEAR OF MANUFACTURE	1998	1999
TRANSFORMER	MAKE	G.E.C.	G.E.C.
	RATING	800kVA	800kVA
	SERIAL No.	94331/01/01	
	OIL CAPACITY	581 L	581 L
	TAP POSITION	3	3
	VOLTAGE RATIO	11 000 / 420 V	11 000 / 420 V
	TOP COVER (BOLT / WELD)	WELDED	WELDED
PROTECTION	HT FUSE SIZE	80A	80A
	MAIN LT CB RATING	1250A	1250A
	THERMAL PROTECTION	NA	NA
	LOAD READING (AMP)	R=700A, W=700A, B=700A	

Table 1 Overview of mini-sub specifications

The following are existing specifications for the LV compartment circuit breakers and their subsequent feeder cables. It is a requirement that the existing cabling arrangement be re-used, however, all LV circuit breakers shall be replaced with similar specifications. Other components in the LV compartment such as analogue ammeters and voltmeters can be replaced with digital ones if the existing CTs (current transformers) and subsequent wiring can be re-used.

Miniature Substation 1				Miniature Substation 2			
Description	Rating	Load Description	Feeder Cable	Description	Rating	Load Description	Feeder Cable
Main LV Compartment				Main LV Compartment			
NS250N MCCB	200A	Block C	95mm ²	NS400N MCCB	400A	Block A	2 x 95mm ²
NS630N MCCB	520A	Block D	3 x 95mm ²	NS250N MCCB	200A	Block B	95mm ²
NS400N MCCB	300A	Block G	2 x 70mm ²	NS400N MCCB	300A	Spare	
NS400N MCCB	300A	Block H	2 x 70mm ²	NS400N MCCB	300A	Block F	2 x 70mm ²
NS100N MCCB	80A	DB-MB	25mm ²	NS630N MCCB	630A	PFC Panel 2	3 x 95mm ²
NS630N MCCB	630A	PFC Panel	3 x 95mm ²				
Instrument & Metering Compartment				Instrument & Metering Compartment			
Analogue ammeters 0 - 1250A				Analogue ammeters 0 - 1250A			
Analogue voltmeter 0 - 500V				Analogue voltmeter 0 - 500V			
Emergency Section				Emergency Section			
MCCB	250A	Emergency section busbar	2 x 95mm ²	MCCB	200A	Emergency section busbar	
MCB	20A	Surge arrestor		MCB	20A	Surge arrestor	
MCB	60A	Block D	35mm ²	MCB	100A	Block F	50mm ²
MCB	60A	Block G	35mm ²	MCB	80A	Block A	35mm ²
MCB	60A	Block D	35mm ²	MCB	60A	Block B	35mm ²
MCB	60A	Block G	35mm ²				
MCB	60A	Block H	35mm ²				
MCB	30A	DB-GH Gate house	10mm ²				

Table 2 LV compartment component specifications

The main incomer breakers in the respective LV compartments is a 1250A MCCB.

4.2 Miniature Substation Requirements

4.2.1 General

This specification covers the supply and installation of two 800kVA 11000/400V Dyn11 50Hz miniature substations. The mini-substations shall comply with the requirements of the relevant SANS and international standards

4.2.2 Housing Requirements

- The mini-sub housing shall be made of 3CR12 stainless steel
- All welds shall be ground smooth and the joints wiped in order to provide a smooth finish
- All panels, the roof and doors shall be suitably braced and stiffened to ensure rigidity to prevent warping
- The colour of the outer coat of paint on the outer surface shall be an acceptable match to "AVOCADO GREEN", colour C12 of SANS 1091

4.2.3 Concrete Plinth

- It is a requirement that the existing concrete plinths be re-used. Therefore the bidder shall make provision for strength testing the existing plinths and re-enforcing should it be necessary

4.2.4 Base

- Steel bases shall be supplied for the mini-substations
- The bases shall be hot-dip galvanised and then epoxy tar-coated before being painted

4.2.5 Doors

- Long pedestal type hinges with at least two fixing bolts per hinge or similar shall be used to hold the doors
- The pedestal hinges shall be arranged in an opposed fashion such that the doors cannot be lifted off
- Hinges shall be of brass or other corrosion-resistant material
- At least three (3) hinges shall be provided on doors higher than 1.2m

- Reinforced fixing points for the door restraints shall be provided for both the door and the door frame
- The doors shall be fitted with brass or stainless steel lever locks with 180° movement.
- The locking mechanism shall have a catch on the rear, which catches behind the frame or door entry surround. The locking mechanism as well as the catch shall be backed by brass or stainless steel plates and must be pad-lockable
- Bypass bolts and nuts shall be used to fix the hinges

4.2.6 High Voltage (HV) Compartment

- The HV compartment shall be equipped with a bulk oil-filled ring main unit (RMU) with a fused tee-off, unless otherwise specified
- All RMU or other HV switchgear installed on the mini-substations shall be fitted with integral testing facilities
- The minimum clearances between connecting cables and jumpers, and any sharp metal edges shall be at least 75mm
- Resin bound wood or other suitable dielectric material shall be used to maintain the phase-to-phase and phase-to-earth spacing of the cables and jumpers. The surfaces of these spacers shall be treated to avoid surface tracking
- Only stranded annealed copper conductors shall be used for jumper cables
- All terminals shall be fitted with heat-shrinkable shrouds
- The high tension connections between the fused switch unit and the transformer shall be suitably blanked off to prevent inadvertent access

4.2.7 Transformer Compartment

- The transformer shall be fitted securely in the compartment
- An off-circuit tap switch shall be provided
- The transformer shall be sealed and not contain a silica gel breather

4.2.8 Low Voltage Compartment

- New break out DBs will need to be supplied and installed to accommodate the circuit breakers currently in the LV compartment.

- All equipment designated for the LV compartment shall be dully installed in this Break out DB.
- All cables will be rerouted and connected to the new Break out DBs
- The Break out DB shall have ample size to accommodate all designated equipment and have spare capacity of 15%
- Only one MCB will be installed in the LV compartment (main CB from transformer)
- A rigid angle-iron or folded metal support frame shall be provided in the LV compartment
- The frame shall be bolted down on the base by at least four (4) M16 high tensile steel bolts
- A cable gland plate shall be provided at the bottom of the frame across the full width of the compartment
- The gland plate shall be at 100mm above the plinth height. A minimum distance as required by the bending radius of the cores of the outgoing cable shall be provided between the lowest terminals of major equipment and the gland plate
- The gland plate shall be suitably punched to accept the number and size of the existing cables
- All steel work shall be hot-dip galvanised in accordance to relevant SANS requirements
- A resin bound synthetic wood or other suitable dielectric material panel shall be provided for mounting of all equipment and busbars
- All equipment and busbars shall be flush-mount within a purpose-made sheet metal frame enclosed by a machine-punched removable front panel through which the operating handles of the equipment protrude. Care shall be exercised so that the rear studs of the circuit breakers are properly insulated from the steel chassis. Miniature circuit breakers may be installed in clip-in trays mounted on the frame
- Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross-section in accordance to the relevant SANS requirements
- The existing busbar system has a fault level rating of 30kA, it is therefore recommended that the new busbar system have a similar fault level rating
- Buss bars in miniature substations shall comply with relevant SANS requirements on insulation and clearance values, creepage distance, joints, insulation resistance,

dielectric strength, deflection test, absorption resistance, and rated short-time current withstand

- The busbars shall be supplied for the following applications:
 - Distribution of supply voltage
 - Connecting equipment with ratings exceeding the current rating of 70mm² conductors
 - Collector busbars for parallel cables
 - Connection bars for neutral conductors
 - Earth bars
 - Connection to miniature circuit breakers and moulded-casing circuit breakers (MCCB)
- Equipment shall be fixed to the support panel with bolts, nuts, washers, and spring washers
- Equipment shall be arranged and grouped in a logical fashion, also taking into account load balancing on the busbars
- All equipment shall be flush-mounted behind panels with only circuit breaker and isolator toggles and meter faces protruding. The front panels shall be secured in position by at least 6mm studs and hexagonal chromed brass dome nuts and washers
- Blanking plates shall be fitted over slots intended for future equipment. The blanking plates shall be fixed such that fixing holes do not need to be drilled through the front panel
- All equipment, busbars and wiring (or cabling) shall be completely accessible with the front cover panel removed
- All equipment shall be duly labelled and accurate descriptions (particularly the feeder load and incoming supply) and safety-warning notices shall be given in ENGLISH. The “emergency section” of the LV compartment consist of feeders linked to uninterruptible power supply (UPS) and would need to be duly labelled with safety notices
- Engraved plastic strips shall be used for labels inside the LV compartment. The labels shall bear white lettering on a black background. All labels fixed on the outside casing of the miniature substations shall be engraved metal strips

- Lettering inside the miniature substation shall be at least 4mm high, and be at least 6mm high for labelling outside the miniature substation casing
- The labels shall be fixed to the front panel and must be aligned with the equipment they are meant to describe
- Labels shall not be fixed using glue; they must be secured by means of brass nuts and bolts. There should be sufficient fixing to prevent warping
- Label samples shall be submitted to SARS for approval before manufacturing

4.3 Approval Requirements

- SARS shall be duly notified at least two weeks (10 working days) in advance before the factory acceptance test (FAT) is to be conducted. This is to allow SARS an opportunity to inspect the miniature substations before they are duly completed and ready for testing
- A FAT programme with testing procedure and expected test results shall be sent to SARS at least a week (5 working days) in advance before the FAT date
- Drawings
 - Shop drawings shall be sent to SARS for approval prior to commencement of any manufacturing, both soft copy and A1 hardcopy shall be submitted
 - Schematic and wiring diagrams shall be submitted, both soft copy and A1 hardcopy
 - A complete layout of the internal arrangement of the mini-substations showing all equipment dimensions and constructional details. The positions and method of fixing of busbars shall be shown
 - All labelling information shall be shown on a separate sheet
 - The makes, catalogue numbers and capacities of all equipment schedules shall be shown on a separate sheet
 - If any plinth construction is to be done, then a detail drawing showing concrete mixes, dimensions, opening sizes, steel reinforcing details and holding down bolts fixing details shall be shown

- The approval of drawings shall not relieve the contractor or service provider of their responsibility to SARS for the supply of the mini-substations according to the requirements
- A complete set of “as-built” drawings shall be submitted to SARS within two weeks (10 working days) after delivery of the mini-substations
- Completion of the works will only be declared once all site acceptance tests (SAT) or commissioning and testing has been completed, and all “as-built” drawings submitted to SARS

4.4 Health and Safety Environment and Quality

- The vendor will submit a complete safety file containing all the company’s SHEQ documents.
 - Safety Policy and/or Plan (incl. baseline risk assessment)
 - Health Policy and/or Plan
 - Environmental Management Plan
 - Quality Control Policy and/or Plan