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TECHNICAL

RAIL NETWORK

SPECIFICATION

REPLACEMENT OF OLD OIL/OBSOLETE SWITCHGEAR AT VARIOUS 6.6/11 kV DISTRIBUTION SUBSTATIONS COUNTRYWIDE - PHASE 2 STAGE 3

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PARTICULAR SPECIFICATION

REPLACEMENT OF OLD OIL/OBSOLETE SWITCHGEAR AT VARIOUS 6.6/11 kV DISTRIBUTION SUBSTATIONS COUNTRYWIDE - PHASE 2 STAGE 3

Part C3

Section 7

TABLE OF CONTENTS

7.1 SCOPE

7.1.1 This Specification covers Transnet Freight Rail requirements for the:

7.1.1.1 Design, supply, installation, testing and commissioning of 11kV switchgear at various distribution substations countrywide.

7.1.1.2 Design, supply, installation, testing and commissioning of 380/ 400V distribution panels at Substations indicated in the Bill of Quantities.

7.1.1.3 The dismantling, removal and transportation of old equipment to the respective depot scrapyard.

7.1.2 Details of the substations, their locations and specific electrical equipment required, are specified in the bill of quantities.

7.2 DRAWINGS AND SPECIFICATIONS

7.2.1 All work shall be done in accordance with Specifications listed in section 4.1 of the Scope of Works.

7.2.2 Drawings, manuals and other documentation shall be supplied in compliance with requirements in section 2.4 of the Scope of Works specification CEE.0224 including its Appendix.

7.3 MATERIALS

7.3.1 Only materials which are approved by Transnet Freight Rail shall be used.

7.3.2 The material shall be as per applicable drawings, standard, generic and particular specifications.

7.3.3 Where equipment offered does not comply with standards or publications referred to in the specification, Contractors shall state which standards apply and submit a copy in English or certified translation.

7.3.4 Contractors shall submit descriptive literature consisting of detailed technical specifications, general constructional details and principal dimensions, together with clear illustrations of the equipment offered.

7.3.5 Tenderers shall submit equipment type test certificates for their offers (at tender stage) and routine test certificates for equipment to be supplied (on delivery of equipment) as specified on the contract. These shall be in English or certified translation.

7.4 EQUIPMENT

7.4.1 The Contractor shall supply all equipment necessary to perform the work.

7.5 CONSTRUCTION

7.5.1 The equipment layout design within the substations shall take into account the space constraints and position of fixed equipment within substations to ensure compliance with applicable regulations and operating clearances.

7.6 MEDIUM VOLTAGE SWITCHGEAR

7.6.1 The indoor, medium voltage metal enclosed switchgear shall be in accordance with Specification No. BBB4182 Version 5.

7.6.2 All panels shall be labeled with the 'designation' as reflected in column 1 of the 'Bill of Quantities and Prices'

7.6.3 All circuit breakers/ switchgear shall be rated for 11kV, 3 phase, and 50Hz system.

7.6.4 The rated continuous current shall not be less than 630A.

7.6.5 All incomers and their respective bus couplers on ring fed networks shall be rated at a continuous current of 1250A.

7.6.6 The rated short circuit breaking current shall not be less than 20kA.

7.6.7 The short time withstand current rating for the medium voltage equipment supplied shall not be less than 20kA for 3s.

7.6.8 The contractor shall make provision for making available the Ring Main Unit (for the duration of the contract) in all sites that form part of a distribution ring. This should be included as part of the total tender value (not just a rate).

7.6.9 The RMU shall be rated at 630A (continuous current) and have the overcurrent and Earth fault protection features.

7.6.10 A minimum clearance of 800mm shall be maintained at the rear of the newly installed panels whenever possible. Where this clearance is not possible, the contractor shall obtain an approving site instruction before commencing with the installation. The front shall have sufficient space for the breakers to be racked out and withdrawn with ease.

7.7 LOW VOLTAGE SWITCHGEAR

7.7.1 The indoor low voltage switchgear shall be in accordance with Specification CEE.0082.

7.7.2 The LV switchgear and control gear ASSEMBLIES shall be factory built and constructed as freestanding ASSEMBLIES comprising of several sections and subsections with withdrawable and / or fixed functional units.

7.7.3 The contractor shall install the 230V AC distribution board and complete interconnections to the existing circuit. The board shall be of the wall mounted type.

7.7.4 Circuit breakers are to be provided where fused isolators were used before.

7.7.5 The contractor shall ensure that power supplies to the workshops, offices etc. fed from the old LV boards will have to be kept live at all times by making use of a 20 way

portable LV board (to be provided by the contractor for the duration of the contract where LV boards are to be replaced).

7.7.6 The LV switchgear short circuit current rating shall be as follows:

- 16 kA – where transformer rating is less than or equal to 300kVA.
- 36 kA – where transformer rating is greater than 300kVA but less than or equal to 1MVA.
- 42 kA – where transformer rating is greater than 1MVA.

7.7.7 Miniature circuit breakers (mcb) with a low short circuit current rating (kA rating) shall not be connected directly to the main busbar instead it shall be connected on secondary bus and be protected by a MCCB with kA rating of the main LV board.

7.7.8 The LV panels shall be constructed from heavy gauge steel with a minimum thickness of 2mm.

7.7.9 All removable covers shall require use of a tool for removal. Opening of doors for all MCB groups shall be pad lockable.

7.7.10 Doors shall have the following points of hinging:

- Up to 450mm – 2 hinges
- Up to 800mm – 3 hinges
- More than 800mm – 4 hinges

7.7.11 All doors shall be secured by square key latches as follows:

- Up to 450mm – 2 latches
- Up to 800mm – 3 latches
- More than 800mm – 4 hinges

7.7.12 The busbars shall be mounted on insulators made of non-hygroscopic, non inflammable material.

7.7.13 The busbars shall be insulated using suitably graded heat shrink material.

7.7.14 The material above shall be of standard colours for 'live' busbars and black for the neutral.

7.7.15 Labels shall be worded in English.

7.7.16 All boards shall be so designed to ensure easy access to all control units, wiring etc. Access shall be possible by means of hinged or removable panels, secured to the framework by captive type screws or latches.

7.7.17 Internal control units, wiring etc. shall be accessible sideways and at the back of the panels for ease of maintenance on constrained spaces.

7.7.18 Removable gland plates shall be provided. These gland plates shall be of adequate thickness or construction for the cables to be terminated without distortion of the gland plate, and shall not be less than 2mm mild steel (zinc passivated). Gland Plates shall not

be mounted less than 300mm above ground floor level, alternatively a base frame of suitable depth may be provided.

7.7.19 The door latches and hinges shall be able to withstand an internal arc of magnitude and time.

7.7.20 Doors shall have stops to prevent over swing when opening and to avoid interference with adjacent compartments.

7.7.21 Main busbars, auxiliary busbars, distribution busbars, cable access as well as incoming, outgoing and functional units shall be fully segregated to FORM 3b with the exception of the mcb groups which shall have a minimum of FORM 2b internal degree of separation.

7.7.22 ASSEMBLIES shall be designed to confine internal arcing faults and to direct arcs and gases arising from these away from the possible operator interface points (i.e. back and front).

7.7.23 Provision shall be made to limit pressure build up and / or re-direct gases resulting from an internal arc fault in any section or sub-section.

7.7.24 Each section of the ASSEMBLY shall be equipped with a pressure activated relief flap that shall direct ionised materials and gases away from the operator interface points.

7.7.25 The two main functions of internal arc confinement are to protect the operator in front and also prevent the arc from spreading to any other compartment that might also be energized.

7.8 SWITCHING DEVICES

7.8.1 Switching devices shall be in compliance with Clause 9.0 of Specification No. BBB4182 Version 5.

7.8.2 The circuit breaker and its control panel shall be supplied from the same supplier/manufacturer.

7.8.3 Suitably rated fuse switch disconnectors shall be supplied where these are required (indicated in Bill of Quantities) for the protection of small transformers.

7.9 PROTECTION REQUIREMENTS

7.9.1 Protection system and relays shall be in compliance with Clause 11.0 of Specification No. BBB4182 Version 5.

7.9.2 The protection required per panel shall be as specified below and must comply with the requirements of Specification No. BBB 4182 Version 5 Appendix 1:

7.9.2.1 Incomer:

- Arc flash protection (refer to clause 7.9.2.5 for where a bus- sectionalizer is installed).
- Earth Fault Protection.
- Overcurrent Protection.
- Reverse Power Protection

7.9.2.2 Transformer

- Primary HRC Fuses (transformers <100kVA and/or where specified in Appendix)
- Buchholz Protection (For all transformers not using HRC fuses).
- Oil and winding Over-Temperature Protection (For transformers not using HRC fuses).
- Primary Over-current and Earth Fault Protection.

7.9.2.3 HV Cable:

(a) Supply and Ring:

- Overcurrent Protection.
- Earth Fault Protection.
- Differential Pilot Wire Protection (Where specified in Bill of Quantities).

(b) Radial:

- Earth Fault Protection.
- Overcurrent Protection.

7.9.2.4 HV Transmission Line:

- Overcurrent Protection.
- Earth Fault Protection.
- Sensitive Earth Fault Protection.
- Auto-reclosing.

7.9.2.5 Busbars (With Bus sectionalizer):

- Arc flash protection (Zoned) Protection.

7.9.3 Arc flash protection shall be provided for all Medium Voltage switchgear panels and shall be implemented in accordance with clause 11.4 of Specification No. BBB 4182 Version 5.

7.9.4 The Contractor shall provide reverse power protection, intertripping and phase failure protection/monitoring where stated above and/or specified in Bill of Quantities.

7.9.5 Intertripping protection shall only trip the associated HV and MV breakers. In the event where the HV breaker trip, the same applies to the MV and LV breakers when the MV breaker trips.

7.9.6 Contractor shall be responsible for design, install and commissioning of the intertripping protection mentioned in 7.9.5 above.

7.10 INDICATING INSTRUMENTS

7.10.1 Indicating instruments shall be in compliance with Clause 12.0 of Specification No. BBB4182 Version 5.

7.10.2 Ammeters shall be installed in all panels, excluding bus sectionalizer and fuse switch disconnector panels. The current in all three phases shall be readable.

7.10.3 Voltmeters shall be installed where indicated in Bill of Quantities, and must be labeled whether it indicates cable or busbar voltage side.

7.10.4 Maximum demand ammeters shall be installed on all transformer panels.

7.11 ENERGY METERS

7.11.1 Energy meters shall be in compliance with Clause 13.0 of Specification No. BBB4182 Version 5.

7.11.2 Energy meters (kWh meters) shall be installed where indicated in Bill of Quantities.

7.11.3 Metering test blocks shall be provided where energy meters are installed.

7.12 CURRENT AND VOLTAGE TRANSFORMERS

7.12.1 Current and voltage transformers shall be in compliance with Clauses 14.0 and 15.0 of Specification No. BBB4182 Version 5.

7.12.2 The current transformers shall be supplied with ratios as indicated in Bill of Quantities.

7.12.3 The CT ratio's given in Bill of Quantities were recorded from the existing old equipment at the distribution substations. The Contractor shall be responsible to verify that the CT ratios and other ratings are suitable for the protection requirements at each substation.

7.12.4 Current transformers for 'Differential Protection' shall be of class X, and for other protection these shall be of accuracy class 10P and accuracy limit factor 10.

7.12.5 The Contractor shall provide a 10 A rated test winding on protection CT's.

7.12.6 Voltage transformers shall be installed on the cable side.

7.12.7 All current transformers shall be suitable for use in both 6.6kV and 11kV circuits.

7.12.8 All incomer panels shall be provided with a voltmeter. Where there is no specific incomer (or through-feed) a VT shall be installed on the busbar side and a voltmeter in one of the panels. In instances where a bus-section is installed, the VT's shall be on cable side of incoming breakers.

7.12.9 Dual ratio voltage transformers (6.6/11kV) are required for 6.6 kV substations or other substations with other voltage ratings besides 11kV. VT's shall have a secondary output of 110V.

7.12.10 A VT selection relay shall be provided where more than one VT is installed in a substation.

7.13 CABLING AND WIRING

7.13.1 All cabling and wiring shall be in accordance with specification BBC0198 Version 1, CEE0023 and SANS 10142-1.

7.13.2 The contractor shall replace the transformer supply cables, from the switchgear, with new cables at all sites.

7.13.3 Tenderers shall quote for a XLPE cable for all sites, with the estimated length given in the Bill of Quantities. The cables shall be rated for 11kV with the current rating based on the current/present application (6.6kV or 11kV).

7.13.4 The quotation for the transformer cable shall include the necessary termination on both sides.

7.13.5 In case where circuit breaker (incoming) cables need replacement, Transnet Freight Rail Supervisor shall communicate the instruction to the Contractor.

7.13.6 No joining of cables will be allowed. The Contractor shall provide cables that are long enough for the application. Joining of cables will only be done in exceptional cases on approval by the contract supervisor.

7.13.7 All cables shall terminate in compression type glands. These glands shall be fitted with neoprene shrouds.

7.13.8 All dissimilar metal connections (Cu to Al) shall be made using bi-metallic clamps that are specifically designed and manufactured to make that particular connection (ad hoc fabricated clamps are not acceptable).

7.13.9 All copper connections to steel (galvanized) shall be tinned.

7.14 EARTHING

7.14.1 Earthing of the substation shall be done in accordance with drawing no. CEE-PA-23. A 95 mm^2 Cu cable shall however be used instead of a 10 mm^2 as indicated on the drawing.

7.14.2 A new meter box and earth spike shall be installed at all substations.

7.14.3 The earth resistance reading of the earth spike shall be less than 5 ohms. Tenderers shall make provision in their offers for installing trench earthing to achieve the required earth reading, where required. No ground wetting or chemical improvement of ground conductivity will be acceptable.

7.14.4 Conductive aggregate material like Marconite may be used to improve the soil resistivity on very dry areas. However, this does not exempt the contractor from installing adequate earth mat.

7.14.5 Tenderers shall provide a rate for trench earthing.

7.15 BATTERIES AND BATTERY CHARGERS

7.15.1 The contractor shall supply and install batteries and battery charger units in accordance with specification CEE 0085, with all relevant cabling in locations as indicated in the Bill of Quantities.

7.15.2 The supply voltage for all control circuits shall be 110V.

7.15.3 The Contractor shall install a battery under-voltage relay in all the substations.

7.15.4 Batteries supplied under this contract shall be of the Nickel Cadmium type.

7.15.5 The capacity of the battery shall be 10AH for up to 4 panels, thereafter 29AH shall be supplied.

7.15.6 The contractor will be responsible for disposing of the old battery sets following an environmentally controlled procedure. It should be assumed that all the old batteries are Nickel Cadmium.

7.16 TRAINING

7.16.1 The contractor's team of supervisors could be required to attend a Transnet Freight Rail electrical safety course and be authorised to supervise the Contractor's staff whilst working in the substations on this contract. Transnet Freight Rail will organise the course and details will be communicated to the successful tenderer. The contractor shall pay for the training.

7.16.2 The tenderers shall submit details of the operation and maintenance training courses of the new equipment offered with the tender.

7.16.2.1 These will be conducted by the supplier/Contractor for the training of Transnet Freight Rail maintenance staff in the operation and maintenance of the equipment supplied. The courses shall include theoretical as well as practical tuition.

7.16.2.2 This training shall be offered for each Depot area in which equipment will be installed. Training for relay setting/operation may be conducted centrally.

7.17 TESTING AND COMMISSIONING

7.17.1 The contractor shall perform all pre-commissioning tests on the switchgear and other related material and components. Transnet Freight Rail reserves the right to witness these tests. The test results shall be recorded and submitted to Transnet Freight Rail.

7.17.2 The equipment shall be inspected or tested and approved by Transnet Freight Rail Quality Assurance at the factory or Contractors workshop prior to it being taken to site. Only once the approval has been granted can the equipment be taken to site for installation.

7.17.3 The contractor shall perform earth resistance tests at each substation prior to installing new equipment in order to determine whether or not new earthing is required (based on clause 7.14.3 of this specification).

7.17.4 The contractor shall supply all test equipment and instruments.

7.17.5 Functional on-site tests shall be conducted by the contractor on all items of equipment and circuitry to prove the proper functioning and installation thereof.

7.17.6 The contractor shall submit a detailed list of on-site tests for the approval of the Project Manager or Supervisor.

7.17.7 At the completion of the on-site tests, the Project Manager or Supervisor or his representative shall either sign the tests sheets (supplied by the Contractor) as having witnessed the satisfactory completion thereof, or hand to the Contractor a list of defects requiring rectification.

7.17.8 Transnet Freight Rail shall be notified at least 14 days prior to performing these tests.

7.17.9 Transnet Freight Rail shall perform final commissioning tests prior to the equipment being energised on site.

7.17.10 Acceptance by the Transnet Freight Rail Supervisor of satisfactory completion of on-site tests in no way relieves the Contractor of his obligation to rectify defects which may have been overlooked or become evident at a later stage.

7.17.11 On completion of commissioning, the Contractor will hand the equipment over to the Project Manager or Supervisor in terms of relevant instruction.

END