

## Section 7. Technical Specifications

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|---------------------------------|-----------------------|
| Invitation for Tender No. Date: | As per tender notice. |
| Tender Package No:              | GRF -009              |

**Name of the tender: Supply, Installation, Testing & Commissioning of 132KV, 25 MVAR, 50 HZ, 3 phase Shunt Reactor including associated protection equipment for APSCL.**

### a. Technical Specification of 132 KV, 25 MVAR, 50 Hz Shunt Reactor

| Sl. No | Description  | Unit     | APSCL Requirement   |
|--------|--|----------|---|
| 01     | Name of Required Equipment   |          | <b>132 KV, 25 MVAR Shunt Reactor</b>                          |
| 02     | Name of Manufacturer   |          | Hyosung/ Siemens/ ABB/ Trench/ Hyundai.                       |
| 03     | Country of Origin  |          | To be filled  |
| 04     | Quantity   | Sets     | 03  |
| 05     | Standard   |          | IEC-60076   |
| 06     | Type   |          | Oil immersed, Outdoor Shunt Reactor                           |
| 07     | Rated voltage of shunt reactor   |          |   |
|        | a) Rated voltage of line terminal  | kV       | 132   |
|        | b) Rated voltage of neutral point  | kV       | 33  |
| 08     | Rated current  | A        | 109.48  |
| 09     | Rated reactance at rated voltage   | $\Omega$ | 696.94  |
| 10     | Rated Frequency  | Hz       | 50  |
| 11     | Number of Phases   |          | 03  |
| 12     | Guaranteed Losses at rated voltage and frequency corrected to 75°C winding temperature (kW)      |          | To be filled  |
| 13     | Vector Group   |          | Star with neutral brought out (YN)                            |
| 14     | Cooling  |          | ONAN  |
| 15     | Method of Earthing   |          | Solid   |
| 16     | Type of windings   |          | Graded  |
| 17     | Rated voltage of windings  | kV       | 132   |
| 18     | Highest voltage for equipment (Um- Reactor must be able to operate continuously at this voltage) | kV       | 145   |
| 19     | Rated lightning impulse withstand voltage at:<br>- HV terminals<br>- HV neutral end terminals    | kV<br>kV | 650<br>>95  |
| 20     | Rated power frequency withstand voltage at<br>- HV terminals<br>- HV neutral end terminals       | kV<br>kV | 275<br>>38  |
| 21     | Rated Power  | MVAR     | 25  |
| 22     | Bushing  |          |   |
|        | a) Type  |          | Oil Impregnated Paper(OIP) Condenser Type Bushing             |
|        | b) Maker's name and country of manufacturer  |          | Micafil, Switzerland/ NGK, Japan/ ABB, Sweden/ Trench, France |
|        | c) Voltage class (HV)  |          | 170 kV  |
|        | d) Momentary power frequency withstand voltage: HV/Neutral                                       |          | To be filled  |
|        | e) One-minute power frequency  |          |   |





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|    | withstand voltage  |          |   |
|    | Dry (kV)   |          | HV/Neutral: 315/95  |
|    | Wet (kV)   |          | HV/Neutral: 275/80  |
|    | f) Full wave impulse withstand and voltage (kV)                                      |          | HV/Neutral: 650/200   |
|    | g) Total creepage distance in air (mm) : HV/Neutral                                  |          | To be filled  |
| 23 | Current Transformer (CT)   |          |   |
|    | a) Purpose of CT   |          | # CT for Winding temperature indicator and oil temperature indicator & # Neutral CT (Toroidal CT) |
|    | b) Ratio of Neutral CT   |          | 200/1   |
|    | c) Burden of Neutral CT  | VA       | 50  |
|    | d) Class of Neutral CT   |          | 5P20  |
| 24 | Magnetic Characteristic: Linear to percent of rated voltage                          | %        | 130   |
| 25 | Maximum temperature rise at Um:<br>- Windings<br>- Hot spot of windings<br>- Top Oil |          | 55<br>68<br>50  |
| 26 | Terminal Connection<br>- HV Terminals<br>- HV neutral end terminals                  |          | Bushing (AIS)<br>Bushing (AIS)  |
| 27 | Approximate Size   |          |   |
|    | a) Size of complete assembled reactor  | mm×mm×mm | To be filled  |
|    | b) Size of largest part arranged for transportation                                  | mm×mm×mm | To be filled  |
| 28 | Vibration Level  | Microns  | Not more than 200 microns peak to peak. Average microns shall not exceed 60 microns peak to peak. |
| 29 | Maximum sound pressure level   | dB       | 83  |
| 30 | Type of cooling system   |          | Radiator bank and Cooling Fan   |
|    | a) Number of radiators   |          | To be filled  |
|    | b) Number of Fan   |          | To be filled  |
| 31 | Auxiliary Supply Voltage   | V-ac     | AC 415/230 V, 50 Hz   |
| 32 | Control/Protection Voltage   | V-dc     | DC 220 V  |
| 33 | Auxiliary device   |          |   |
|    | a) Oil level indicator on Main tank  |          |   |
|    | Quantity   |          | To be filled  |
|    | Manufacturer   |          | To be filled  |
|    | Type of oil level indicator  |          | To be filled  |
|    | No of auxiliary contact (NO/NC)  |          | To be filled  |
|    | b) Oil temperature indicator   |          |   |
|    | Quantity   |          | To be filled  |
|    | Manufacturer   |          | To be filled  |
|    | Type of oil temperature indicator  |          | To be filled  |
|    | No of auxiliary contact (NO/NC)  |          | To be filled  |
|    | c) Winding temperature indicator   |          |   |
|    | Quantity   |          | To be filled  |
|    | Manufacturer   |          | To be filled  |
|    | Type of oil temperature indicator  |          | To be filled  |
|    | No of auxiliary contact (NO/NC)  |          | To be filled  |
|    | d) Buchholz relay for Main Tank  |          |   |
|    | Quantity   |          | To be filled  |
|    | Manufacturer   |          | To be filled  |
|    | Type of Buchholz relay   |          | To be filled  |

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|    | No of auxiliary contact (NO/NC)  |  | To be filled              |
| e) | <b>Pressure Relief Device</b>  |  |                           |
|    | Quantity   |  | To be filled              |
|    | Manufacturer   |  | To be filled              |
|    | Type of pressure relief device   |  | To be filled              |
|    | No of auxiliary contact (NO/NC)  |  | To be filled              |
| f) | <b>Transformer Oil</b>   |  |                           |
|    | Quantity   |  | To be filled              |
|    | Manufacturer   |  | To be filled              |
|    | Type of Oil  |  | To be filled              |
|    | Technical data of oil  |  | To be filled              |
| g) | <b>Terminal box of auxiliary device</b>  |  |                           |
|    | Quantity   |  | To be filled              |
|    | Manufacturer   |  | To be filled              |
|    | Protection class   |  | IP-55                     |
| 34 | <b>List of tests (IEC 60076 &amp; other relevant IEC standard)</b>   |  |                           |
| a) | <b>Routine test</b>  |  |                           |
|    | - Measurement of winding resistance  |  | Test report required      |
|    | - Measurement of reactance   |  | Test report required      |
|    | - Measurement of losses  |  | Test report required      |
|    | - Lightning Impulse (LI) Test  |  | Test report required      |
|    | - Switching Impulse (SI) Test  |  | Test report required      |
|    | - Induced voltage test with partial discharge measurement  |  | Test report required      |
|    | a) Long Duration AC (ACLD)   |  |                           |
|    | - Separate Voltage Source Test   |  | Test report required      |
|    | - Oil Test including Dissolved Gas Analysis and function tests of auxiliary equipment, before and after Dielectric test  |  | Test report required      |
|    | - Measurement of insulation of core  |  | Test report required      |
|    | - Oil Leakage test   |  | Test report required      |
| b) | <b>Type tests</b>  |  |                           |
|    | - Temperature rise test  |  | Type Test report required |
|    | - Switching Impulse (SI) tests   |  | Type Test report required |
|    | - Dissolved Gas Analysis of Shunt Reactor Oil shall be carried out before and after the Temperature Rise Test  |  | Type Test report required |
| c) | <b>Special tests</b>   |  |                           |
|    | - Dielectric tests; tests under Routine and Type Tests. The applicable special dielectric tests are: Chopped wave lightning impulse. This test is a requirement at all system voltages on line terminals and shall be at 110% of the full wave impulse level: Routine test |  | Test report required      |
|    | - Measurement of zero-sequence impedance: Routine test   |  | Test report required      |
|    | - Determination of sound levels to IEC 60076-10: Type test   |  | Test report required      |
|    | - Measurement of the harmonics of the no-load current: Routine test  |  | Test report required      |
|    | - Measurement of the mutual impedance between phases.  |  | Test report required      |
|    | - Determination of capacitance, windings to earth and between windings: Routine test   |  | Test report required      |
|    | - Measurement of insulation resistance to earth and loss angle of insulation   |  | Test report required      |

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|  | system capacitances: Routine test  |  |                      |
|  | - Determination of magnetic characteristic: to be linear up to 125% of nominal voltage |  | Test report required |
|  | - Vibration test (Routine): 200 $\mu$ m peak-to-peak maximum                           |  | Test report required |
|  | - Measurement of Capacitance & dissipation factor (Tan delta) for winding and bushings |  | Test report required |
|  | - Measurement of current at low voltage  |  | Test report required |
|  | - SFRA (Sweep Frequency Response Analysis) test.                                       |  | Test report required |

**b. Technical Specification of Protection Panel for 132 KV, 25 MVAR , 50 Hz Shunt Reactor**

| Sl. No | Description                            | Qty. | Unit. | APSCL Requirement                               |
|--------|--|------|-------|---|
| 01     | Name of Required Equipment             |      |       | Protection Panel                                |
| 02     | Name of Manufacturer                   |      |       | To be mentioned                                 |
| 03     | Country of Origin                      |      |       | EU  |
| 04     | Size of Cubicle (W×D×H)                |      | mm    | Approx. 1200×800×2200                           |
| 05     | Type of Panel                          |      |       | IP-32   |
| 06     | Bay control and back-up protection     | 03   | Set   | ABB IED RET-670                                 |
| 07     | Set of Trip circuit supervision relay  | 03   | Set   | To be mentioned                                 |
| 08     | Synchronous switching device (CSD):    | 03   | Set   | To be supplied                                  |
|        | Country of origin                      |      |       | EU  |
|        | Model Number                           |      |       | To be mentioned                                 |
| 09     | Schematic Diagram of Protection System |      |       | To be provided by the Tenderer with the tender. |
| 10     | Auxiliary voltage                      |      | Volt  | 220 V DC  |
| 11     | Lay out of protection panel            | 1    | set   | Should be provided with the tender.             |

**Scope of Work:**

1. Design, Manufacturing and Supply of 03 sets of 25 MVAR, 132 KV, 3-Phase Shunt Reactor as per technical specifications, export seaworthy packing and delivery based on CFR Chittagong port as per INCOTERMS 2010.
2. Supply of Flexible Conductor and control cable for interfacing of local control panel & protection panel.
3. Supply, installation, testing, commissioning and interfacing of Protection panel with RET-670 Relay (RET-670 would be associated with Differential, REF, Backup protection, Overcurrent, Thermal Overload, earth fault , over voltage, under voltage, AC directional overcurrent) and associated equipment must be done for enabling protection system of Shunt reactor with the existing system as per instruction of Engineer-in-charge.
4. Extension of Earthing system, modification and connection of DC Distribution panel & LVAC Distribution panel must be done by the Supplier/Contractor.
5. Installation including Complete Outdoor Civil Works including Shunt Reactor Foundation, Cable Trench and Switchyard surface finishing, mechanical fabrication and other related works should be done by supplier at the APSCL 132 KV switchyard as per instruction of Engineer-in-charge.







6. Testing and Commissioning of Shunt Reactor:

Testing and Commissioning of the Shunt Reactor should be up to satisfaction of the APSCL. The result of different test following IEC standard should be as per manufacturer's certificate.

(i) Factory Acceptance Test & Inspection:

A. FAT & inspection of Shunt Reactor:

B. FAT & inspection of Protection System

At least the following tests of Shunt Reactor will be carried out according to IEC standard (60076) by the supplier with the witness of 03 (Three) APSCL Engineer/representative. All test result (both type test and routine test) must be provided as paper document and also with soft copy. The FAT of Protection system will also be carried out with the presence of 03 (Three) APSCL Engineer/representative.

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| List of tests ( Test must be performed according to IEC standard)  |
| General inspection: Visual, dimensional and accessories check  |
| <b>a) Routine test</b>   |
| - Measurement of winding resistance  |
| - Measurement of reactance   |
| - Measurement of losses  |
| - Lightning Impulse (LI) Test  |
| - Switching Impulse (SI) Test  |
| - Induced voltage test with partial discharge measurement  |
| <b>a) Long Duration AC (ACLD)</b>  |
| - Separate Voltage Source Test   |
| - Oil Test including Dissolved Gas Analysis and function tests of auxiliary equipment, before and after Dielectric test  |
| - Measurement of insulation of core  |
| - Oil Leakage test   |
| <b>b) Special tests</b>  |
| - Dielectric tests; tests under Routine and Type Tests. The applicable special dielectric tests are: Chopped wave lightning impulse. This test is a requirement at all system voltages on line terminals and shall be at 110% of the full wave impulse level: Routine test |
| - Measurement of zero-sequence impedance: Routine test   |
| - Determination of sound levels to IEC 60076-10: Type test   |
| - Measurement of the harmonics of the no-load current: Routine test  |
| - Measurement of the mutual impedance between phases.  |
| - Determination of capacitance, windings to earth and between windings: Routine test   |
| - Measurement of insulation resistance to earth and loss angle of insulation system capacitances: Routine test   |
| - Determination of magnetic characteristic: to be linear up to 125% of nominal voltage   |
| - Vibration test (Routine): 200 $\mu$ m peak-to-peak maximum   |
| - Measurement of Capacitance & dissipation factor (Tan delta) for winding and bushings   |
| - Measurement of current at low voltage  |
| - SFRA (Sweep Frequency Response Analysis) test.   |

All expenses related with the test including the followings must be borne by the Supplier.

The 03 (Three) Engineer/ representative of APSCL will witness the factory test of Shunt Reactor on manufacturer premises. In addition, the FAT of Protection system will also be carried out with the presence of 03 (Three) APSCL Engineer/representative. All expenses related to tests including following would be carried out by the supplier.

- a) Hotel, air tickets, food and all local transportation cost of three (03) APSCL's representative would be borne by supplier during FAT.

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- b) Daily pocket allowance of USD 150.00 of three (03) APSCL's representative would be borne by supplier.
- c) Total duration of combine FAT will be seven (07) working days.
- d) Detailed FAT/Inspection schedule will be submitted by supplier before one (01) month of FAT.

**(ii) Post Landing Test & Inspection:**

Post landing inspection shall be done after arrival of the Shunt Reactor at site of APSCL. The following tests will be performed at consumer field site after supply and installation of the Shunt Reactor.

- a. General inspection
- b. Winding resistance test
- c. Insulation resistance test, including PI & DAR
- d. Dielectric insulation break down test of Insulation Oil.

**# Quality will only be certified after successful commissioning of the Shunt Reactor.**

**Terms and Conditions:**

- a) Warranty should be two (02) years after successful commissioning and put in operation of the Reactor.
- b) Name plate data of Reactor which shall include serial no., company and type, detail specifications etc. should be provided by supplier of Reactor Company.
- c) 03 copies of O&M manual, as built wiring diagram, single line diagram, installation diagram, outline drawing, functional drawing and manual of OLTC should be provided by the supplier.
- d) Installation, testing and commissioning work should be done at APSCL substation.
- e) Special tools and equipment's for O&M should also be supplied by the supplier (if necessary)
- f) The supplier/bidder/contractor or his representative should visit the site before submitting the bid. It will be assumed that the supplier/bidder/contractor or his representative has visited the site before submission even they did not visit the site.
- g) All type test certificate should be provided from internationally recognized testing laboratory with the tender document.
- h) All clamping elements of the core should be earthed reliably in one point.

In the capacity of:

Duly authorized to the sign the Tender on behalf of the Tenderer.

Date:

