

		BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION BUSINESS ENGINEERING MANAGEMENT										
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	STATION	ARIYALUR, TAMILNADU										
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SECTION 1

INTENT, DESIGN CRITERIA, SYSTEM REQUIREMENT AND SCOPE

1.1 SCOPE

- a) This specification is intended to specify the requirements for design, engineering, manufacture, assembly, stage testing, inspection, testing before supply, packing & forwarding, transportation to site, **(unloading, storage at site and shifting from storage to its foundation is excluded from contractor's scope)** and complete erection of all equipment and accessories of DG set, testing of the system, trial run, commissioning of the system, final painting and carrying out acceptance test at site of **500kVA Diesel Generator Set** along with its accessories and auxiliary equipments/ instruments etc. as mentioned in this section and in various other sections of this specification for **765 / 400KV AIS SUB STATION AT ARIYALUR** of **TAMILNADU TRANSMISSION CORPORATION LTD (TANTRANSCO)**.
- b) **The Contract shall be on lump-sum basis for the package. Within the scope of the contract, no variation shall be admissible to the Contractor so far the input remains unchanged. In case of change in scope after award of the contract, the additions/ deletions to the scope shall be settled on the basis of mutually agreed rates.**
- c) The requirements specified under SECTION 2 and SECTION 3, of the specification shall be considered as part of this section. In case of variance between various sections on the scope of supply, requirements of Section 1 shall prevail.
- d) It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respect to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Customer, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his/their judgment is not in full accordance with the specifications.
- e) The bidder shall be deemed to have understood completely all the tender drawings and documents and quoted accordingly. Contract shall be on lump sum basis for the package. Within the scope of the contract, no variation shall be admissible to Contractor so far the inputs remain unchanged.
- f) In case of any deviation, the bidder shall indicate separately the deviations clause-wise with respect to the specification in the 'Schedule of Deviation' as described in Section 5. Deviations in any other form including clarifications/assumptions/ etc. will not be considered and it will be construed that the bid conforms strictly to the specification.
- g) This specification makes it obligatory for the contractor to arrange/ obtain necessary approval/ clearance from statutory organizations wherever applicable for the plant/ machinery/ sub-systems under the scope specified
- h) The system shall be designed to suit the extreme of outside conditions as given in "Section 3" of the specification.
- i) The term 'Customer' appearing in this specification shall refer to **TANTRANSCO**, the term 'Purchaser' shall refer to **BHEL** and the term 'Contractor' shall refer to the **successful Bidder**.



1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 SYSTEM REQUIREMENT & DESIGN CRITERIA

Besides, the following shall be considered:

1. Six terminals shall be brought out in alternator terminal box. Enough space and termination arrangement shall be ensured inside the alternator terminal box for 4 runs of 4CX240 sqmm Al XLPE cable.
2. Neutral shall be formed in the AMF control panel, which shall be solidly grounded through GI pipe electrode. DG body shall be separately grounded through another GI pipe electrode.
3. ACB for DG has been provided in the 415V AC distribution board. Power circuit is therefore not required in AMF panel. Control scheme shall be accordingly made for auto start of DG and auto-closing and trip of DG ACB.
4. 3 nos. CTs for differential protection shall be mounted in neutrals brought to the AMF panel while other 3 CTs shall be mounted on the LVAC Board. These six nos. CTs are in other's scope of supply. However DG supplier shall ensure provision for mounting of 3 CTs in AMF Panel.
5. Relays for point no. b, f, g, h & i mentioned in clause no 2.3.7 of section-2 shall be provided by purchaser in LVAC board, however Contractor shall provide necessary provisions in AMF panel for point no. a, c, d & e for initiating the DG shutdown sequence.

1.3 SCOPE OF SUPPLY & SERVICES

The equipment and services to be furnished under this contract are detailed here under for reference. The items, though not specifically mentioned but required for safe and satisfactory operation of system will also be treated as included and the same shall be supplied at **NO EXTRA COST** to Purchaser.

1.3.1 SCOPE OF SUPPLY

A. Main Item

The scope covers supply of one (1) no. Diesel Generator Set of stationary type having a net electrical output (after considering deration for engine and alternator separately due to temperature rise in side the enclosure and on account of power reduction due to auxiliaries) of 500 kVA at specified site conditions of 50 °C ambient temperature & 100% relative humidity. The enclosure should be sound proof & weather proof in line with latest CPCB norms. Essential components are:

- i) Diesel engine of adequate capacity to deliver 500 kVA at 50 °C ambient temperature & 100% relative humidity.
- ii) Suitable alternator directly coupled to the engine through coupling, complete with all accessories.
- iii) Automatic Voltage Regulator
- iv) Complete starting arrangement including 2 sets of Battery (one set comprises of 2 batteries of 12 V each) & battery charger (2 sets) with leads.
- v) Base frame and 1 set of AVM pads.



- vi) Day tank of 990 litres capacity complete with accessories viz. breather, level indicator, fuel inlet & outlet, air vent, drain plug, inlet arrangement for direct filling. The tank shall be painted with oil resistant paint.
- vii) Motor operated pump and a set of hoses to transfer fuel from barrel to day tank.
- viii) Engine cooling and lubrication system
- ix) Engine air filtering system
- x) Exhaust silencer package with insulation beyond flexible connection upto the stack height as per the latest CPCB norms.
- xi) 20 mtrs. of fuel piping with valves and fittings between day tank & engine. The day tank will be placed near the DG set and would be within 5mtrs from the periphery of the DG set.
- xii) AMF control panel complete with all standard protection, alarm/ annunciations and meters necessary for 500 KVA DG set
- xiii) Adequate Illumination & ventilation arrangement for DG set enclosure.
- xiv) All lubricants consumable touch up paints etc. for first testing & commissioning at site. Fuel (**HSD**) for first commissioning shall be provided by purchaser.

B. Mandatory Spares

The following mandatory spares for engine of 500kVA shall be provided:

Sl. No.	Item Description	Unit	Qty.
1.	Oil Seal	Set	1
2.	Lub. Oil Filter	Nos.	3
3.	Diesel primary fuel filter	Nos.	3
4.	Diesel secondary fuel filter	Nos.	3
5.	Sealing ring between lub. Oil filter cover and bowl	Nos.	2
6.	Sealing Ring	Nos.	2
7.	V-Belt	Nos.	2

 It is to be noted that no mandatory spare shall be used during commissioning of the equipment. Any spares required for commissioning purpose shall be supplied separately by the contractor.

C. Standard Tools & Tackles

Bidder shall include one set of standard tools and tackles required for erection, testing, commissioning & maintenance of equipment. The list of tools required shall be furnished in the bid.

**1.3.2 SCOPE OF SERVICES**

The contractor shall provide following, services:

- A. Design, manufacture, shop testing including assembly test.
- B. Dispatch transportation to Site.
- C. Complete Erection, Testing & Commissioning of DG set.
- D. Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF.
- E. Submission of drawings, data sheet, design calculations & printed erection, operation & maintenance manual as per documentation requirement laid down in clause no. 2.6.1 of section-2.
- F. The draft O&M manual shall be submitted within 4 weeks after award of contract.

The O&M manual shall contain the following information:

- Description of the system and equipment with design particulars
- Scheme of operation and interlocks in AMF panel with the purchasers LVAC board
- Instruction for installation, operation, maintenance and repair at site.
- Recommended inspection practices and inspection schedule.
- Ordering information for all replaceable parts

1.4 EXCLUSIONS

The following has been excluded from the bidder's scope:

- 1.4.1 **Unloading, Storage at site & shifting from storage to DG foundation.**
- 1.4.2 Supply and laying of power & control cables, if required.
- 1.4.3 Supply of GI flat and 2 nos. GI/CI pipe electrodes for equipment earthing.
- 1.4.4 Interlocking of the DG Set with the existing system. However, provision for the same shall be made in the AMF control panel by supplier.
- 1.4.5 Construction of foundation for DG set, day tank & electric pump & provision of canopy. However, the supplier shall submit the foundation & canopy details of these equipment.
- 1.4.6 Fuel (**HSD**) for first commissioning and site testing of DG set.

1.5 INSPECTION AND TESTING

Inspection and testing of DG set shall be done at manufacturer works as per Customer's approved GTP/drawing/QAP. Also refer section-2 clause no: 2.7 for type test and routine test requirement.

**Bidder shall quote under the following heads:**

Sl. No.	Description	Quantity
1.0	500 kVA DG Set comprising of but not limited to: - Diesel engine complete with all accessories - Alternator directly coupled to engine through coupling, complete with all accessories - Automatic voltage regulator - Complete starting arrangement with starter motor, 2 sets of batteries (4 nos. of 12V each) and 2 nos. battery chargers - Day tank of 990 litres capacity - Motor driven oil pump to transfer fuel to day tank - Engine cooling and lubrication system - Engine air-filtration system - Exhaust silencer package - Acoustic and weather proof enclosure as per latest CPCB norms - AMF panel for control, metering and alarm - Inspection & testing of DG set as per specification	1 set
2.0	Complete erection material but not limited to: - 1 set of AVM Pads. - Exhaust silencer package with 1 lot of MS class 'B' exhaust piping complete with hardware and fittings - 1 lot of fuel piping from day tank to engine complete with hardware & fittings. - 1 lot of thermal insulation of exhaust piping and silencer beyond flexible connections. - Set of valves, strainers and unloading hose pipes as required - First fill of lube oil.	1 lot
3.0	Standard tools and tackles for maintenance	1 Set
4.0	Mandatory Spares (spares as per clause 1.3.1 B)	1 Lot
5.0	Erection, Testing & Commissioning of DG	1 Lot



SECTION-2

EQUIPMENT SPECIFICATION

2.1 TECHNICAL REQUIREMENTS

2.1.1 The rating of DG set is as follows:

- (a) DG set net output after considering deration for engine and alternator separately due to temperature rise in side the enclosure and on account of power reduction due to auxiliaries shall be 500 kVA, 1500RPM, 0.8Pf, 415V, 3 phase, 50Hz. The above ratings are the minimum requirements.
- (b) DG sets shall also be rated for 110% of full load for 1 hour in every twelve hrs. of continuous running.

2.1.2 The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:

- (a) Voltage variation +5% of the set value provision shall exist to adjust the set value between 90% to 110% of nominal Generator voltage of 415V.
- (b) Frequency 50Hz +2%

2.1.3 The Diesel Generator and other auxiliary motor shall be of H class with temperature rise limited to Class-F for temperature rise consideration.

2.1.4 NOISE LEVEL & EMISSION PARAMETERS: These shall be as per latest Notification of MOEF

2.2 PLANT DESIGN

2.2.1 DIESEL ENGINE

- (a) The engine shall comply with the IS 10002/BS 5514/ISO 3046; latest edition
- (b) Diesel engine shall be turbo charged multi cylinder V-type in line type with mechanical fuel injection system.
- (c) The engine with all accessories shall be enclosed in an enclosure to make it work silently (within permissible noise level) without any degradation in its performance.
- (d) The Diesel Engines shall be directly water-cooled. Cooling of water through radiator and fan as envisaged.
- (e) The fuel used shall be High Speed Diesel oil (HSD) or Light Diesel Oil (LDO) as per IS:1460.

2.2.2 Air Suction & Filtration

- (a) Suction of air shall be from indoor for ventilation and exhaust flue gasses will be let out to outside atmosphere, Condensate traps shall be provided on the exhaust pipe.
- (b) Filter shall be dry type air filter with replaceable elements

2.2.3 FUEL AND LUBRICATING OIL SYSTEM

The engine shall have closed loop lubricating system. No moving parts shall require lubrication by hand prior to the start of engine or while it is in operation.

2.2.4 ENGINE STARTING SYSTEM

Automatic electric starting by DC starter motor shall be provided.



2.2.5 FUEL INJECTION AND REGULATOR

- (a) The engine shall be fitted with electronic governor suitable for class A-1 as per IS 10000.
- (b) The engine shall be fitted with a heavy, dynamically balanced flywheel suitable for constant speed governor duty.

2.2.6 ALTERNATOR

- 2.2.6.1 The alternator shall comply with BS 2613/IS 4722/IEC 34; latest edition.
- 2.2.6.2 The alternator shall be of continuously rated duty, suitable for 415 V, 3 phases, 50 Hz. Power development having brush-less, synchronous, self-excited, self-regulating system.
- 2.2.6.3 The alternator shall be drip-proof, screen protected as per IP-23 degree of Protection.
- 2.2.6.4 The rotor shall be dynamically balanced to minimize vibration.
- 2.2.6.5 The alternator shall be fitted with shaft mounted centrifugal fan.
- 2.2.6.6 It shall have the winding of class H but limited to Class-F for temperature rise consideration.
- 2.2.6.7 The Alternator regulator shall be directly coupled to the engine and shall be complete with the excitation system, automatic voltage regulation of +/- 1%, voltage adjusting potentiometer and under/over speed protection.

2.2.6.8 Terminal Box

- (a) Six (6) output terminals shall be provided in alternator terminal box.

~~Terminals shall be suitable for 1 No. of single core, 630 mm² XLPE cables per phase for 500kVA DG set.~~

Terminals shall be suitable for 4 runs of 4CX240 sqmm Al XLPE cables and accordingly enough space and termination arrangement shall be ensured inside the alternator terminal box for accommodating these cables. Sizing calculation for the cable is subject to TANTRANSCO approval.

The neutral shall be formed in AMF panel. The generator terminal box shall be suitable to house necessary cables and should be made of non-magnetic material.

- (b) The alternator with all accessories shall be enclosed in an enclosure to make it work silently (within permissible noise level).

2.2.7 COUPLING

- (a) The engine and alternator shall be directly coupled by means of self-aligning flexible flange coupling to avoid misalignment.
- (b) The coupling shall be provided with a protecting guard to avoid accidental contract.

2.2.8 MOUNTING ARRANGEMENT

- (a) The engine and alternator shall be mounted on a common heavy duty, rigid fabricated steel base frame constructed from ISMC of suitable sections.
- (b) Adequate number of anti-vibration mounting pads shall be fixed on the common base frame on which the engine and the alternator shall be mounted to isolate the vibration from passing on to the common base frame or the foundation of the D.G. Set.

2.2.9 PERIPHERALS

2.2.9.1 FUEL TANK



- (a) The Fuel tank of 990 Litre capacity shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent, an air breather and necessary piping. The tank shall be painted with oil resistant paint and shall be erected in accordance with Indian explosive act of 1932. Fuel tank shall be kept outside of enclosure. The fuel piping shall be carried out to connect the D.G set kept inside.
- (b) For transferring fuel to Fuel tank transfer pump is envisaged. The capacity of transfer pump shall be adequate to fill the day tank in about 30 minutes. Fuel pump shall be electrically driven.

2.2.9.2 BATTERY and BATTERY CHARGER

- (a) Two nos. 24V batteries complete with all leads, terminals and stand shall be provided. Each battery shall have sufficient capacity to give 10 nos. successive starting impulse to the diesel engine.
- (b) The battery charger shall be complete with transformer, suitable rating (415 V, 3 Ph., 50 Hz./230V, 1Ph., 50 Hz) rectifier circuit, charge rate selector switch for "trickle"/"boost" charge, D.C. ammeter & voltmeter, annunciation panel for battery charge indication / loading / failures.
- (c) The charger shall float and Boost Charge the battery as per recommendation of manufacturer of battery. The charger shall be able to charge a fully discharged battery to a state of full charge in 8 Hrs. with 25% spare capacity.
- (d) Manual control for coarse and fine voltage variation shall be provided. Float charger shall have built-in load limiting features. Ripple shall not be more than 1%(r.m.s) to get smooth DC voltage shall be provided.
- (e) Charger shall be provided with Out-put Voltmeter & Ammeter.
- (f) Changeover scheme for selecting battery and battery charger by changeover switch should be provided.

2.3 CONTROL AND INSTRUMENTATION

- 2.3.1 Each D.G. Set shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel along with each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF Panel shall have IP-52 degree of Protection as per IS: 12063.
- 2.3.2 The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.
- 2.3.3 Testing facility for automatic operation of D.G.Set shall be provided in AMF panel.
- 2.3.4 A three attempt starting facility using two impulse timers and summation timer for engine shall be proved and if the voltage fails to develop within 40 sec. from receiving the first impulse, the set shall block and alarm to this effect shall be provided in the AMF panel.
- 2.3.5 Following instruments shall be provided with Diesel Engine
 - (a) Lube oil pressure gauge
 - (b) Water temperature thermometers
 - (c) Engine tachometer/HR
 - (d) Any other instruments necessary for DG Set operation shall be provided.



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- 2.3.6 DG set shall be capable of being started/ stopped manually from remote as well as local. (Remote START/STOP push button shall be provided in 415V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. Circuit breaker is closed.
- 2.3.7 The diesel generator shall commence a shutdown sequence whenever any of the following conditions appear in the system :
- Over speed
 - Overload
 - High temperature of engine and cooling water.
 - High temperature inside enclosure.
 - Low lube oil pressure
 - Generator differential protection
 - Short circuit protection
 - Under voltage
 - Over voltage
- Further interlocking of breaker shall be provided to prevent parallel operation of DG set with normal station supply.*
- 2.3.8 Following indication lamps for purposes mentioned as under shall be provided in AMF panel :
- 2.3.8.1. Pilot indicating lamp for the following:
- Mains ON
 - Alternator ON
 - Charger ON/OFF
 - Breaker ON/OFF
 - Main LT Supply ON/OFF
- 2.3.8.2. Visual annunciation shall be provided for set shut down due to:
- Engine overheating
 - Low oil pressure
 - Lack of fuel
 - Set failed to start in 30 secs after receiving the first start impulse
 - High cooling water temperature
 - Low level in daily service fuel tank
 - Over speed trip
 - Audio & visual Annunciation for alternator fault.
- 2.3.9 Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.
- 2.3.10 AMF panel shall have facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode.



Following shall also be provided in AMF panel:

- (a) Frequency meter
- (b) 3 Nos. single phase CT's for metering
- (c) 3 Nos. (Provided by LT swgr manufacturer) single phase CT's with KPV 300V & RCT 0.25 ohm for differential protection of DG Set on neutral side only for 500 kVA.
- (d) One (1) DC Ammeter (0-40A)
- (e) One (1) DC Voltmeter (0-30V)
- (f) One (1) Voltmeter Selector switch
- (g) One (1) AC Ammeter
- (h) One (1) AC Voltmeter
- (i) Three (3) Timers (24V DC)
- (j) Two (2) Auto/Manual Selector Switch
- (k) Two (2) Auto/test/Manual Selector Switch
- (l) Eleven (11) Aux. Contactors suitable for 24V DC
- (m) One (1) Motorized potentiometer for voltage adjustment
- (n) Two (2) Set Battery charger as specified in Technical Specification
- (o) One (1) Set Phase & Neutral bus bars.
- (p) Any other item required for completion of Control scheme shall be deemed to be included.

2.4 D.G. SET Enclosure

2.4.1 General requirements

- 2.4.1.1 Diesel engine, alternator, AMF panel, Batteries and Chargers shall be installed outdoor in a suitable weather-proof enclosure which shall be provided for protection from rain, sun, dust etc. Further, in addition to the weather proofing, acoustic enclosures shall also be provided such that the noise level of acoustic enclosure DG set shall meet the requirement of MOEF The diesel generator sets should also conform to Environment (Protection) Rules, 1986 as amended. An exhaust fan with louvers shall be installed in the enclosure for temperature control inside the enclosure. The enclosure shall allow sufficient ventilation to the enclosed D.G. Set so that the body temperature is limit to 50°C. The air flow of the exhaust fan shall be from inside to the outside the shelter. The exhaust fan shall be powered from the DG set supply output so that it starts with the starting of the DG set and stops with the stopping of the DG set. The enclosure shall have suitable viewing glass to view the local parameters on the engine.
- 2.4.1.2 Fresh air intake for the Engine shall be available abundantly; without making the Engine to gasp for air intake. A chicken mess shall be provided for air inlet at suitable location in enclosure, which shall be finalized during detailed engineering.
- 2.4.1.3 The Enclosure shall be designed and the layout of the equipment inside it shall be such that there is easy access to all the serviceable parts.
- 2.4.1.4 Engine and Alternator used inside the Enclosure shall carry their manufacturer's Warranty for their respective Models and this shall not degrade their performance.
- 2.4.1.5 Exhaust from the Engine shall be let off through Silencer arrangement to keep the noise level within desired limits. Interconnection between silencer and engine should be through stainless steel flexible hose/ pipe.



2.4.2 All the Controls for Operation of the D.G. Set shall be easily assessable. There should be provision for emergency shut down from outside the enclosure.

2.4.3 Arrangement shall be made for housing the Battery set in a tray inside the Enclosure.

2.4.4 Construction Features:

2.4.4.1 The enclosure shall be fabricated from at least 14 Gauge CRCA sheet steel and of Modular construction for easy assembling and dismantling. The sheet metal components shall be pre-treated by Seven Tank Process and Powder coated (PURO Polyester based) both-inside and outside for long life. The hardware and accessories shall be high tensile grade. Enclosure shall be given a lasting anti-rust treatment and finished with pleasant environment friendly paint. All the hardware and fixtures shall be rust proof and able to withstand the weather conditions.

2.4.4.2 Doors shall be large sized for easy access and provided with long lasting gasket to make the enclosure sound proof. All the door handles shall be lockable type.

2.4.4.3 The Enclosure shall be provided with anti-vibration pads (suitable for the loads and vibration they are required to carry) with minimum vibration transmitted to the surface the set is resting on.

2.4.4.4 High quality rock wool of required density and thickness shall be used with fire retardant thermo – setting resin to make the Enclosure sound proof.

2.4.5 Provision for Neutral/ Body earthing

Points shall be available at two side of the enclosure with the help of flexible copper wires from alternator neutral, and electrical panel body respectively. The earthing point shall be isolated through insulator mounted on enclosure.

2.5 INSTALLATION ARRANGEMENT

DG set enclosed in enclosure shall be installed on Concrete Pedestal 300mm above FGL

2.6 DOCUMENTS

2.6.1 Following drawings and data sheet shall be submitted for approval:

- (a) Data sheet for Engine, Alternator, Battery, AMF panel and Enclosure
- (b) BHP calculation for the engine
- (c) GA drawing of DG set
- (d) Layout of DG set in the enclosure along with sections
- (e) GA and schematic of AMF panel
- (f) Arrangement of inclined roof and pedestal.
- (g) Foundation details for the DG set
- (h) Foundation details for 990 litre diesel tank & electric pump, canopy arrangement.

2.6.2 The D G Set shall be supplied with

- (a) D G Set test certificate
- (b) Engine Operation & maintenance Manual.
- (c) Engine Parts Catalogue.
- (d) Alternator Operation, maintenance & Spare parts Manual.



(e) Alternator test certificate.

2.7 TYPE TESTS:

The bidders are requested to enclose with their tender, a copy of the type test certificates for all the equipments offered in full shape conforming to latest issue of IS obtained from a Government/Government recognised lab. The above type test certificates should accompany the drawings for the equipments duly signed under seal by the institution who has issued the type test certificate. The above type test should have been conducted not earlier than 5 years on the date of tender opening (i.e. **30.09.2016**). The tests should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from the date of opening of the tender) or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL. The type test if conducted shall be witnessed by BHEL/Customer. Type tests on base Diesel Engine shall conform to IS.10002 and Type Tests on Alternator shall conform to IS.4722: 1968 Clause 20.3.2.1. or their latest equivalents.

ROUTINE TESTS:

i. **On base Diesel Engine:** (to be carried out in the presence of Board's Engineer free of cost to the Board at the works of the Diesel Engine manufacturer).

1. Rating Test as per IS.10000 – Part-VIII.
2. Fuel Consumption Test as per IS.10000 – Part-VIII.
3. Governing Test as per IS.10000 – Part-VI.

ii. **On Alternator:** (to be carried out in the presence of Board's Engineer free of cost to the Board at the works of the alternator manufacturer).

1. Measurement of resistance of windings.
2. Measurement of Insulation Resistance of windings.
3. High Voltage Tests.
4. Open circuit characteristics.
5. Short circuit characteristics.
6. Voltage Regulation Tests.
7. Full load temperature rise test on any one alternator by resistance method using Kelvin's Double Bridge.

All these tests shall conform to IS.4722-1968 Clause-20.3.2.2 and IS.7132 or their latest equivalents. The supplier shall furnish copies of test certificates of the tests conducted on the equipments and shall despatch the diesel generator sets only after approval of these test report.

2.8 Commissioning Checks

In addition to the checks and test recommended by the manufacturer, the Contractor shall carryout the following commissioning tests to be carried out at site.

2.8.1 Load Test

The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG Set rating:

During the load test, half hourly records of the following shall be taken:

- (a) Ambient temperature.



- (b) Exhaust temperature if exhaust thermometer is fitted.
- (c) Cooling water temperature at a convenient point adjacent to the water output from the engine jacket.
- (d) Lubricating oil temperature where oil cooler fitted.
- (e) Lubricating oil pressure.
- (f) Colour of exhaust gas
- (g) Speed
- (h) Voltage, wattage and current output.
- (i) Oil tank level

The necessary load to carry out the test shall be provided by the purchaser.

2.8.2 Insulation Resistance Test for Alternator Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500V megger shall not be less than $IR = 2 \times (\text{rated voltage in KV}) + 1$

2.8.3 Check of Fuel Consumption

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.

2.8.4 Insulation Resistance of Wiring

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

2.8.5 Functional Tests

- (a) Functional tests on control panel.
- (b) Functional test on starting provision on the engine.
- (c) Functional tests on all Field devices.
- (d) Functional tests on AVR and speed governor.

2.8.6 Measurement of Vibration

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250microns.

2.8.7 Noise Level check as per relevant standard

2.8.8 The tests shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for Test environment condition & background noise will be applied as per IS: 12065.

2.9 Interfacing with Substation Automation Auxiliary panel:

2.9.1 Necessary provision should be made to have following control and indication for SAS auxiliary panel from AMF panel:

A. For Remote Indication (Digital Input to SAS Auxiliary Panel)

- 1) Mains 1 ON
- 2) Mains 2 ON
- 3) Alternator ON
- 4) Charger 1 ON/OFF



- 5) Charger 2 ON/OFF
- 6) Main 1 LT Supply ON/OFF
- 7) Main 2 LT Supply ON/OFF
- 8) Engine Over Heating
- 9) Lack Of fuel
- 10) Low Oil Pressure
- 11) Set Failed to start 30 Sec after receiving the first start
- 12) Impulse
- 13) High Cooling Water Temperature
- 14) Low Level in daily service fuel Tank
- 15) Over speed trip
- 16) Alternator Fault
- 17) Breaker ON/OFF

B. For control from remote (Digital Output from SAS Auxiliary Panel)

- 1) Circuit Breaker Open
- 2) Circuit Breaker Close
- 3) DG Voltage Lower
- 4) DG Voltage Raise
- 5) DG Speed Lower
- 6) DG Speed Raise

C. Analog Signal output to SAS Auxiliary Panel (4-20mA)

- 1) Voltage R-Y
- 2) Voltage Y-B
- 3) Voltage B-R
- 4) Current R Ph
- 5) Current Y Ph
- 6) Current B Ph



SECTION – 3

GENERAL TECHNICAL REQUIREMENTS

3.0 FOREWORD

The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

- a) Customer : M/s Tamil Nadu Transmission Corporation Limited
- b) Project Title : 765/400KV AIS SUB STATION AT ARIYALUR
- c) Transport facilities : Road/Rail

Physical and other parameters:

3.1.1 Location of the substation

- 3.1.2 Nearest Railway station : Tindivanam
Railway : Southern Railway

3.1.3 Meteorological data

- (i) Atmosphere : Polluted
- (ii) Maximum ambient temperature : 50°C
- (iii) Minimum ambient temperature : 20°C
- (iv) Maximum daily average ambient air temperature : 45° C
- (v) Maximum yearly average ambient air temperature : 32° C
- (vi) Maximum Humidity (%) : 100%
- (vii) Average thunder storm days per annum : 50
- (viii) Average rainy days per annum : 65
- (ix) Average annual rainfall (mm) : 750 mm
- (x) No. of months during which tropical monsoon condition prevail : 3
- (xi) Maximum wind pressure : 150 Kgf/Sqmm

(xii) Altitude above MSL : <1000M

(xii) Basic Wind Speed : 39 m/s (Zone -2)

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

3.1.4 System Parameter

SL No	Description of parameters	765kV System	400 kV System
1.	System operating Voltage	765kV	400k V
2.	Maximum operating voltage of the system(rms)	800kV	420k V
3.	Rated Frequency	50HZ	50H
4.	Number of Phases	3	3
5.	Rated Insulation Levels (i)Full wave impulse withstand voltage.(1.2 to 50 micro sec) (ii)Switching impulse withstand voltage(250/2500 micro sec) dry and wet. (iii) One minute power frequency dry withstand voltage (rms)frequency dry withstand voltage (rms)	2100kVp 1550kVp 830kV	1550kVp 1050kVp 630kV
6.	Corona extinction voltage	508kV	320kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV,and 266kV rms for 400kV system	2500 microvolts	1000 microvolts
8.	Minimum creepage distance (25mm/kV)	20000 mm	10500 mm
9.	Rated short circuit current for 1 sec. Duration	50kA	63kA
10.	System neutral earthing	Effectively earthed	Effectively earthed
11.	Seismic acceleration	0.3g horizontal	0.3g horizontal



12.	Plinth level of switchyard	500mm above FGL	500mm above FGL
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3.1.5 AUXILIARY POWER SUPPLY :

Auxiliary electrical equipment's maintenance equipment's etc., shall be suitable for operation on the following supply system.

3 phase AC Supply	415V, 3 phase 4 wire 50 Hz, neutral grounded AC supply -10% to +10%, frequency +/- 5%
1 phase AC supply	240V, single phase, 50 Hz neutral grounded AC supply
DC supply	220, 2 wire DC supply + 10% to -15%, Ungrounded 48V, 2 wire DC supply , Positively earthed

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.2.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardware's, insulators, bus bar . These designs / drawing shall be got approved by the purchaser before commencing the manufacture / construction / erection and are to be as per latest IS /IEC.

3.2.2 GENERAL:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section - I of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT



The bidder shall furnish make/manufacture, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standards specified in each section.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.5 TYPE TEST:

The Type Test for all the equipments/materials used for this project should have been conducted in any approved Government/Govt. recognized laboratories conforming to latest IS/IEC. The above type test certificates should accompany the drawings of the materials equipments, duly signed under seal by the Institution, who have issued the type test certificate. The above type test should have been conducted not earlier than 5 years, subject to no change in design as on the originally scheduled date of technical bid opening i.e. **30.09.2016**

In case the type tests were conducted earlier than 05 (Five) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test (s) at no extra cost to the purchaser (BHEL).

The original type test certificates shall be furnished for verification on request. TANTRANSCO/BHEL reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative at no extra cost. Non furnishing of type test certificates by the tenderers, will be liable for rejection.

3.6 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate ISS/IEC. The workmanship shall be of the best grade and the entire



construction in accordance with the best modern practice.

The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipment's should operate without undue vibration and with the least practicable amount of noise.

3.7 **INSPECTION :**

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL , reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller , provided rerolling of structural steel section is done from billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly .

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.



The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.8 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.9 PRE COMMISSIONING TESTING (if applicable) :-

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO and the BHEL

for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.10 DOCUMENTATION : All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.11 PAINTING. GALVANISING:

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5**.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre**. Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard. The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.12 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.13 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.14 FUNGI-STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.



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3.15 DEGREE OF PROTECTION

The supplier shall propose following Degree of protection for those equipment/Items for which the degree of protection has not been specified in the specification for the approval of BHEL/TANTRANSCO. The decision of BHEL/TANTRANSCO shall be final. The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed outdoor: IP-55
- b) Installed indoor in air conditioned area: IP-42
- c) Installed in covered area IP:52
- d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.16 RATING PLATES, NAME PLATES AND LABELS :-

The equipment's shall be provided with a rating plate or plates marked with but not limited to following data whatever needs to that particular equipment's.

- (a) Manufacturer's name or trade mark.
- (b) Serial number and type design making it possible to get all relevant information from the manufacturer.
- (c) Year of manufacture.
- (d) Rated voltage
- (e) Rated insulation level.
- (f) Rated frequency
- (g) Rated Normal current.
- (h) Rated short circuit breaking current
- (i) First pole to clear factor
- (j) Rated duration of short circuit
- (k) Rated auxiliary D.C. supply voltage of closing and opening devices.
- (l) Rated pressure of SF6 gas for operation and interruption.
- (m) Rated out of phase breaking current.
- (n) Rated supply voltage of auxiliary circuit.
- (o) Rated supply frequency of auxiliary circuits.
- (p) Purchase Order Number and Date.

The rating plate shall be visible in position of normal service and installation.

The rating plate shall be weather proof and corrosion proof.

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may be required by the BHEL/TANTRANSCO. The rating plate for each equipment shall be according to IEC requirements.



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Alternately two separate plates one with Hindi and other with English inscriptions may be provided. During approvals drawings of Rating/name plates/labels shall also be submitted.

3.17 EARTHING :

The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50x8mm mild steel flat to be provided for connection to station earth mat.

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat of Size 75X12 mm. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.18 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.



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Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm.copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

TB sizes for incoming power supply shall be informed/confirmed during drawing approval stage.

3.19 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled Neoprene /EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of



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gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

3.20 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

3.21 DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:

Delivery of goods shall be made by the supplier in accordance with the terms specified by the BHEL in its schedule of requirements.

3.22 INCIDENTAL SERVICES:

The Supplier is required to provide any or all the services broadly outlined in the Technical specification. Any other minor incidental service related to the scope of work like providing necessary assistance whether specifically mentioned or not must be carried out by the Supplier at his own cost. All tools, Tackles Plant etc., required for completion of above works shall be brought by the Supplier.

3.23 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/TANTRANSCO for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/TANTRANSCO shall be final and binding on the Supplier.

3.24 LIST OF DRAWINGS AND DOCUMENTS :



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The drawings for the equipments provided by the TANTRANSCO shall be followed strictly by the bidder while designing. For the rest of the equipments, the design is in the scope of the bidder and the same got approved by the TANTRANSCO.

The bidder shall furnish One sets of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the offer.

- (i) General outline drawings showing dimensions and shipping weights, quantity of insulating media , etc.
- (ii) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (iii) Schematic diagrams of breaker offered for control supervision and re- closing.
- (iv) Structural drawing, design calculations and loading data for support structures.
- (v) Foundation drilling plan and loading data for foundation design.
- (vi) The Type Test Reports
- (vii) Bill of materials shall be furnished along with drawings.

The supplier shall, within 1 weeks of placement of order submit Six sets of final version of all the above drawings for BHEL/TANTRANSCO's approval. The TANTRANSCO shall communicate its comments/approval on the drawings to the supplier within reasonable period. The Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for TANTRANSCO's approval within two weeks from the date of comments.. However the drawing approval does not absolve the supplier from complying with the terms of the specification.

The following should be supplied to each consignee circle along with the initial supply of equipment's ordered.

- 1) Five copies of printed and bound volumes of operation, maintenance and erection manual in English along with the copies of approved drawings and type test reports etc.
- 2) Three sets of manuals detailed in item (1) shall be supplied to the TANTRANSCO/BHEL within one week from the date of approval of drawings.
- 3) The spares for the Equipment's ordered under the scope of the Contract should also be supplied to the consignee circle along with initial supply of the breakers.
- 4) It should be noted that if the above conditions are not fulfilled the initial payment will not be released.

3.25 **QUALITY ASSURANCE PLAN :**

The bidder shall invariably furnish following information along with his offer. (i) Statement giving list of important raw materials including but not limited to:

- (a) Contact material
- (b) Insulation
- (c) Porcelain
- (d) Sealing material
- (e) Contactor, limit switches, etc. in control cabinet.

Name of sub-supplier for the raw materials, list of standards according to which the raw materials



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are tested, list of test normally carried out on raw materials in presence of bidder's representative, copies of test certificates.

- (ii) Information and copies of test certificates as in
- (i) above in respect of bought out accessories.
- (iii) List of areas in manufacturing process, where such inspections are normally carried out for quality control and details of such tests and inspections.
- (iv) Special features provided in the equipment to make it maintenance free.
- (v) List of testing equipment available with the Bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

The supplier shall submit following information to the TANTRANSCO.

- 1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- 2) Type test certificates of the raw material and bought out accessories.
- 3) Quality assurance plan (QAP) withhold points for TANTRANSCO inspection. The quality assurance plan and hold point shall be discussed between the employer and supplier before the QAP is finalized.

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker.

3.26 **TEMPERATURE RISE :**

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of the sun shall not exceed 30 deg. Cover an ambient of 50 deg. C limits specified in relevant IEC. When the standard specify the limit of temperature rise these shall be exceeded when corrected for the difference between ambient temperature at site and that specified in the approved specifications. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

3.27 **FITTINGS AND ACCESSORIES :**

Following is a partial list of some of the major fittings and accessories to be furnished by contractor as an integral part of the equipment.

Operation mechanism housing complete with :

- (a) Locking arrangement.
- (b) Heaters equipped with automatic thermostatic control and control switch. (c) Cable glands.
- (d) Local/Remote change over switch.
- (e) Operation Counter.
- (f) Terminal Blocks.
- (g) Control switches to cut off control power supply.
- (h) MCCBs/MCBs are required with permanent identification marks for protection of D.C.



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circuits and A.C. circuits.

(i) Two earthing terminals.

3.28 PACKING AND FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal Transport, as the case may be and suitable to withstand handling transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their final destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' final destination and absence of heavy mechanized handling facilities, at all points in transit.

The packing, marking and documentation within and outside the package shall comply strictly with such special requirements as shall be expressly provided for in the Contract or in any subsequent instructions issued by BHEL.

3.29 SPECIFICATION FOR NITRYL BUTYL RUBBER

The gaskets are to be used in tanks exposed to Transformer mineral oil/SF6 at about 110° C.

1. Hardness should be Shore A 70 ± 5 .
2. Tensile Strength should be min. 10.8N/sq.mm (Minimum)
3. Elongation strength should be 270% (Minimum)

3.30 APPROVAL PROCEDURE

The scheduled dates for the submission of drawings as well as for, any data/information to be furnished by the Employer would be as per the following schedule. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the BHEL/TANTRANSCO. The following schedule shall be followed generally for approval.



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i.	First Submission	7 days after LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the BHEL/TANTRANSCO failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer below mention Title block for Submission of Documents.

Title Block

Customer	M/s Tamil Nadu Transmission Corporation Limited
Project:	765/400KV Air Insulated substation Ariyalur
Contractor	BHEL

3.31 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

Drawings, GTP ,Type Test Reports and List of Past Supplies. Drawings & Documents

submitted at the time of offer shall be subject to review at contract stage.

3.31 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	7	10	5
2	Drawings "As Built "	-	-	10	



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3	Type Test Reports	1	7	10	
4	Erection Manuals	-	7	10	
5	Operation and Maintenance Manuals	-	7	10	
6	Manufacturing Quality Plan	-	7	10	
7	Field Quality Plan	-	7	10	
8	Inspection Test Reports	-	7	10	

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later version or any other CAD package along with conversion files for all major items. Final Documentation shall be submitted in bound volumes with details of Customer & Project etc. written on top.



SECTION-4

GUARANTEED TECHNICAL PARTICULARS

D.G.SET

1 GENERAL

- 1.1 Bidder's name and Address
- 1.2 Manufacturer's name, type and address for
 - a) (a) Diesel Engine along with accessories :
 - b) (b) Alternator :
 - c) (c) Exciter :
 - d) (d) Battery :
 - e) (e) Battery Charger :
 - f) (f) D.G. Control Panel for site condition :

2.0 ENGINE

- 2.1 Rating :
- 2.2 Revolutions per minute :
- 2.3 No. Of strokes :
- 2.4 Type of Governor :
- 2.5 Guaranteed fuel consumption
 - (a) At full load :
 - (b) At 3/4 load :
 - (c) At 1/2 load :
 - (d) At 1/4 load :
- 2.6 Lubricating oil consumption :



-
- 2.7 Mechanical efficiency :
- 2.8 Thermal efficiency :
- 2.9 Total weight :

3.0 **ALTERNATOR**

- 3.1 Rated KW capacity :
- 3.2 Rated Terminal Voltage :
- 3.3 Rated Power Factor :
- 3.4 Rated Speed :
- 3.5 Rated Frequency :
- 3.6 No. Of phases :
- 3.7 Efficiencies and power factor at :
- 110% of full load :
- 100% of full load :
- 75% of full load :
- 50% of full load :
- 25% of full load :
- 3.8 Permissible Temperature :
- (a) Armature winding :
- (b) Field winding :
- 3.9 Overload capacity :
- 3.10 Applicable standards :

4.0 **AMF (Auto Mains Failure)**

a Degree of Protection

b Whether the offered DG is type tested



SECTION-5

SCHEDULE TO BE FILLED UP BY THE BIDDER

SCHEDULE-1	Make of important components and details.
SCHEDULE-2	Technical deviation
SCHEDULE-3	Schedule of unpriced BOQ
SCHEDULE-4	Enclosures to Specification Drawings



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SCHEDULE-1

MAKE OF IMPORTANT COMPONENTS OF EQUIPMENTS AND DETAILS

ITEM NAME	NAME OF MANUFACTURER	PLACE OF MANUFACTURE OF ITEM	PLACE OF TESTING & INSPECTION	COMPLIANCE WITH ISO 9001 (YES/NO)

Place

Signature of the authorized representative of

Bidder 'name -----

Date

Designation-----

Company seal-----



SCHEDULE-2

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations/variations/exceptions from the specification:

Section	Clause No. / Page No.	Statement of deviation / Variations / Exceptions

1. In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.
2. If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**
3. Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place

Signature of the authorized representative of

Bidder 'name -----

Date

Designation-----

Company seal-----

**SCHEDULE-3**

Bidders shall attach signed and stamped **unpriced** copy of this BOQ with their technical offer:

Sl. No.	Item Description	Qty	Whether Unit Rates have been furnished in priced bid?
1.	500 kVA DG Set comprising of but not limited to: - Diesel engine complete with all accessories - Alternator directly coupled to engine through coupling, complete with all accessories - Automatic voltage regulator - Complete starting arrangement with starter motor, 2 sets of batteries (4 nos. of 12V each) and 2 nos. battery chargers - Day tank of 990 litres capacity - Motor driven oil pump to transfer fuel to day tank - Engine cooling and lubrication system - Engine air-filtration system - Exhaust silencer package - Acoustic and weather proof enclosure as per latest CPCB norms - AMF panel for control, metering and alarm Inspection & testing of DG set as per specification	1 set	YES
2.	Complete erection material but not limited to: - 1 set of AVM Pads. - Exhaust silencer package with 1 lot of MS class 'B' exhaust piping complete with hardware and fittings - 1 lot of fuel piping from day tank to engine complete with hardware & fittings. - 1 lot of thermal insulation of exhaust piping and silencer beyond flexible connections. - Set of valves, strainers and unloading hose pipes as required - First fill of lube oil.	1 lot	YES
3.	Standard tools and tackles for maintenance	1 Set	YES



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4.	Mandatory Spares (spares as per clause 1.3.1 B)	1 Lot	YES
5.	Erection, Testing & Commissioning of DG	1 Lot	YES

Signature of the authorized representative of Bidder

Name :

Designation :

Place :

Date :



SCHEDULE-4

DRAWINGS

- 1) GA drawing of Switchyard showing locations of DG set and Control Room Building.

