

# BHARAT HEAVY ELECTRICALS LIMITED

## TRANSMISSION PROJECTS ENGINEERING MANAGEMENT



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TITLE ACSR Moose Conductor	SIGN					
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	GROUP	TBEM	W.O. No			
CUSTOMER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)					
PROJECT	110KV Switchyard for Renovation, Modernization and Uprating (RMU) OF Kodayar Power House-I from 1X60MW TO 1X70MW.					

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**SECTION – I**

**SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES**

**1.0 SCOPE**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of ACSR Moose Conductor.

The equipment is required for the following project.

Name of the customer : Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)  
Name of the Project : 110KV Switchyard for Renovation, Modernization & Uprating (RMU) of Kodayar Power House-1 from 1 X 60MW to 1 X 70MW

**1.1 SPECIFIC TECHNICAL REQUIREMENT**

Sl. No.	Description		
1.	Copper equivalent area	sq mm	322.6
2.	Aluminium equivalent area	Sq mm	528.5
3.	Overall diameter	mm	31.77
4.	Stranding number and wire diameter	mm	Al=54/3.53 Steel=7/3.53
5.	Approx. weight of conductor	Kg/m	2.004
6.	Ultimate strength	kg	16120

**1.2 BILL OF QUANTITY**

Sl. No.	Description	Quantity
1.	ACSR Moose Conductor	1000 Meters

**1.3 MANDATORY TYPE TESTS**

Bidder shall submit the valid type test reports for the following . If the Bidder is not having valid Type Test Reports , the Type test shall be conducted by the bidder without any commercial implication to BHEL

1. UTS test
2. Corona extinction voltage test (dry)
3. Radio interference voltage test (dry)
4. DC resistance test

**1.4 QUALITY PLAN**

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

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**TECHNICAL PRE- QUALIFICATION REQUIREMENT**

Customer: Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)  
Project: 110KV Switchyard for Renovation, Modernization & Uprating (RMU) of  
Kodayar Power House-1 from 1 X 60MW to 1 X 70MW

Name of Item: ACSR Moose Conductor

SR. NO	TQR DESCRIPTION	SUPPORTING DOCUMENT TO BE ATTACHED
1.	The Bidder should have supplied ACSR overhead Conductor during the last 7(Seven) years as on the date of technical bid opening of this tender.	a) Copy of Purchase Orders / LR / MDCC / Dispatch instructions/etc.

Prepared by

*[Signature]*  
02/03/2022

*[Signature]*  
02/03/2022  
Checked by

*[Signature]*  
02/03/22  
Approved by

## SECTION – II

### STANDARD TECHNICAL SPECIFICATION

**2.1** This section covers the standard technical requirements of the ACSR MOOSE Conductor. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification, the later shall prevail and shall be treated as binding requirements.

**2.2 TECHNICAL REQUIREMENTS**

- |    |                      |         |
|----|----------------------|---------|
| 1. | Conductor type       | : ACSR  |
| 2. | Commercial name item | : MOOSE |

**2.2.1** The details of the conductor are tabulated below:

a)	Stranding and wire Diameter in mm	54/3.53 mm Al, 7/3.53 Steel
b)	Number of strands	
	Steel center	1
	1 <sup>st</sup> steel layer	6
	1 <sup>st</sup> Aluminium layer	12
	2 <sup>nd</sup> Aluminium layer	18
	3 <sup>rd</sup> Aluminium layer	24
c)	Copper equivalent area	322.6 mm <sup>2</sup>
c)	Sectional area of aluminium	528.5 mm <sup>2</sup>
d)	Total sectional area	597.00 mm <sup>2</sup>
e)	Overall diameter	31.77 mm
f)	Approximate weight	2004 kg/km
g)	Calculated d.c. resistance at 20°C	0.05552 ohm/km
h)	Minimum UTS	161.2kN
i)	Drum Length	As required, generally 1500 – 1800m

**2.2.2** The details of **aluminium strand** are as follows:

i)	Minimum breaking load of strand	
	- before stranding	1.57kN
	- after stranding	1.49kN
ii)	Max. D.C. resistance of strand at 20°C	2.921 ohm/km

**2.2.3** The details of **steel strand** are as follows:

i)	Minimum breaking load of strand	
	- before stranding	12.86 kN
	- after stranding	12.22 kN
ii)	Minimum number of twist to be withstood in torsion test when tested on a gauge length of 100 times diameter of wire	18-before stranding 16-after stranding

### 2.3 APPLICABLE STANDARDS

The ACSR MOOSE Conductor shall strictly conform to the following Indian and International standards, as appropriate:

IS 398 (Part-V): 1996	Aluminium conductors galvanized Steel reinforced
IS 2629:1990	Recommended practice for hot dip galvanizing on iron and steel.
IS 4826:1992	Hot dip galvanized coatings on round steel wires
IS 2633:1992	Method for testing uniformity of coating of zinc-coated articles.
IS 6745: 1990	Methods for determination of mass of Zinc coating on zinc coated iron and steel articles
IS 8263:1990	Methods for radio interference test
IS 1778:1980	Reels and drums for bare conductors
IS 1521:1991	Method for tensile testing of steel wire

### 2.4 TECHNICAL REQUIREMENT AND CONSTRUCTIONAL DETAILS

- 2.4.1 The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasion, scuff marks, kinks (protrusion of wires), dents, press marks, cut marks, wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, power formation or black spots (on account of reaction with trapped rain water etc.), dirt, grit etc.
- 2.4.2 All the aluminium and steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die-marks, scratches, abrasions and kinks after drawing.
- 2.4.3 The steel strands shall be hot dip galvanized and shall have a minimum Zinc coating of **260 gm/m<sup>2</sup>** after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard Preece Test. The finished strands and the individual wires shall be of uniform quality and have the same properties and characteristic as prescribed in ASTM designation: B 498-74.
- 2.4.4 The steel strands shall be preformed and post-formed in order to prevent spreading of strands in the event of cutting of composite core wire. Care shall be taken to avoid damage to galvanization during pre-forming and post-forming operation.
- 2.4.5 For all constructions, each alternate layer shall be stranded in opposite direction. The final layer of wires shall be right hand lay. These conductors will be utilised for stringing various buses & equipment connections both in switchyard area and transformer yard area. ACSR conductors shall conform to the latest relevant standard.
- 2.4.6 The Aluminium strands of the Steel-Aluminium conductor shall be hard drawn from 99.5% pure electrolytic aluminium rods of E.C. Grade. The steel wire strands shall be drawn from high carbon steel rods procured by acid or the basic open-hearth process, the electric furnace process or the basic oxygen process. The Zinc used for galvanising shall be electrolytic high-grade zinc of 99.95% purity.

## 2.5 Joints in wires

### 2.5.1 Aluminium wires

No joints shall be permitted in the individual wires in the outermost layer of the finished conductor. However, joints in the 12 wire and 18 wire inner layers of the conductor shall be allowed but these joints shall be made by cold pressure butt welding and shall be such that no such joints are within 15 metres of each other in other in the complete stranded conductor.

### 2.5.2 Steel wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand splices in any length of the completed stranded steel core of the conductor.

## 2.6 Tolerances

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of individual aluminium and steel strands and lay-ratio of the conductor.

### a) Diameter of aluminium and steel strands (in millimeters):

	Standard	Maximum	Minimum
Aluminium	3.53	3.55	3.51
Steel	3.53	3.60	3.46

### b) Lay ratio of conductor:

		Maximum	Minimum
Steel	6-wire layer	18	16
Aluminium	12-wire layer	14	12
	18-wire layer	13	11
	24-wire layer	12	10

## 2.7 Materials

### 2.7.1 Aluminium

The aluminium strands shall be hard drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%

### 2.7.2 Steel

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition:

Element	-	% composition
Carbon	-	0.50 to 0.85
Manganese	-	0.50 to 1.10
Phosphorous	-	not more than 0.035
Sulphur	-	not more than 0.045
Silicone	-	0.10 to 0.35

### 2.7.3 Zinc

The zinc used for galvanizing shall be electrolytic high grade zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS: 209-1979.

### 2.8 Standard length

The conductor shall be supplied in lengths as required generally in the range of 1500/ 1800 metres.

### 2.9 Tests:

The following type, acceptance and routine tests and tests during manufacturing shall be carried out on the conductor.

#### 2.9.1 Type Tests

Bidder shall submit the valid type test reports for the following . If the Bidder is not having valid Type Test Reports , the Type test shall be conducted by the bidder without any commercial implication to BHEL

a)	UTS test	As per clause No. 2.10.1 below (The number of samples shall be mutually agreed)
b)	Corona extinction voltage test (dry)	As per clause No. 2.10.2 below
c)	Radio interference voltage test (dry)	As per clause No. 2.10.3 below
d)	DC resistance test	As per clause No. 2.10.4 below

#### 2.9.2 Acceptance tests

a)	Visual check for joints, scratches, etc. and lengths of conductor	As per clause No. 2.10.7 below
b)	Dimensional check on strands	As per clause No. 2.10.8 below
c)	Check for lay ratio of various layers	As per clause No. 2.10.9 below
d)	Galvanizing test on steel strands	As per clause No. 2.10.10 below
e)	Torsion and elongation test on steel strands	As per clause No. 2.10.11 below
f)	Breaking load test on strands	As per clause No. 2.10.12 below

In addition wrap test on steel and aluminium strands, dc resistance test on aluminium strands and UTS test on welded joint of aluminium strands shall be carried out as per clauses 12.5.2,12.7& 12.8 respectively of IS:398 (part V)1982.

#### NOTE:

All the above tests except test mentioned at (a) shall be carried out on aluminium and steel strands after stranding only.

#### 2.9.3 Routine tests

- Check to ensure that the joints are as per specification.
- Check that there are no cuts, fins etc. on the strands
- All acceptance test as mentioned in clause 2.9.2 above to be carried out on each coil.

#### 2.9.4 Tests during manufacture

a)	Chemical analysis of zinc used for galvanizing	As per clause No. 2.10.5
b)	Chemical analysis of aluminium used for making aluminium stands	As per clause No. 2.10.6
c)	Chemical analysis of steel used for making steel strands	As per clause No. 2.10.6

#### 2.9.5 Sample batch for type testing

The contractor shall offer material for selection of samples for type testing, only after getting quality assurance plans approved from owner's quality assurance department. The sample shall be manufactured strictly in accordance with the quality assurance plan approved by owner.

### 2.10 TESTING PROCEDURE FOR ACSR MOOSE CONDUCTOR

#### 2.10.1 UTS Test on Stranded Conductor

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to 80 kN and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at a steady rate to 161.2 kN and held for one minute. The applied load shall then be increased until the failing load is reached and the value recorded.

#### 2.10.2 Corona Extinction Voltage Test

Two samples of conductor of 5m length shall be strung with a spacing of 450 mm between them at a height not exceeding 8.0 m above ground. This assembly shall be tested as per Section 3, corona extinction voltage shall not be less than 320kV (RMS) Line to ground for 400 kV system.

#### 2.10.3 Radio Interference Voltage Test

The sample assembly similar to that specified above shall be tested as per Section 3. Maximum RIV level (across 300 ohm resistor at 1 MHz) at 305 kV (RMS) line to ground voltage shall be 1000  $\mu$ V.

#### 2.10.4 D.C Resistance Test on Stranded Conductor

On a conductor sample of minimum 5 m length two contact clamps shall be fixed with a pre-determined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20<sup>0</sup>C as per clause no. 12.8 of IS:398 (Part V)-1982. The resistance corrected at 20<sup>0</sup>C shall conform to the requirements of this specification.

#### 2.10.5 Chemical Analysis of Zinc

Samples taken from the zinc ingots shall be chemically/spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.

#### **2.10.6 Chemical Analysis of Aluminium and Steel**

Samples taken from the Aluminium ingots/ coils/ strands shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements in this specification.

#### **2.10.7 Visual Check for Joints, Scratches etc.**

Conductor drums shall be rewound in the presence of the inspector. The inspector shall visually check for scratches, joints, etc. and that the conductor generally conforms to the requirements of this specification. The length of conductor wound on the drum shall be measured with the help of counter meter during rewinding.

#### **2.10.8 Dimensional Check for steel and Aluminium Strands.**

The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

#### **2.10.9 Check for Lay –ratios of various Layers.**

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this specification and clause no. 9.4 and 9.5 of IS-398 (Part-V) 1982.

#### **2.10.10 Galvanising Test**

The test procedure shall be as specified in IS: 4826-1968. The material shall conform to the requirements of this specification.

#### **2.10.11 Torsion and Elongation Tests on Steel Strands**

The test procedures shall be as per relevant clauses of IS 398 (Part V): 1982. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand before stranding & 16 after stranding. In case test sample length of less or more than 100 times the standard diameter of the strand, the minimum number of twist will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4% for a gauge length of 200 mm.

#### **2.10.12 Breaking load test on welded Aluminium strand:**

Two Aluminium wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to with stand the minimum breaking load of the individual strand guaranteed by the bidder.

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## **PROJECT INFORMATION AND GENERAL TECHNICAL REQUIREMENTS**

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

### **[1] PROJECT INFORMATION**

**1.1 Project Title:** Renovation, Modernization & Uprating of Kodayar Power Power House - I from 1x60MW to 1x70MW in Tirunveli Generation Circle in the Kanyakumari District, Tamil Nadu, India .

**Owner:** TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION  
(TANGEDCO)

**Transport facilities :** Road/Rail

### **1.2 Meteorological Data**

- (i) Maximum ambient temperature : 50°C
- (ii) Minimum ambient temperature : 20°C
- (iii) Maximum daily average ambient air temperature : 45° C
- (iv) Maximum yearly average ambient air temperature : 32° C
- (v) Maximum Humidity (%) : 100%
- (vi) Average thunder storm days per annum : 50
- (vii) Average rainy days per annum : 90
- (viii) Average annual rainfall (mm) : 1000 mm
- (ix) Maximum wind pressure : 150 Kgf/Sqmm
- (x) Altitude above MSL : Below 1000M

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

**[2] ELECTRICAL DATA**

**2.1 MAIN ELECTRICAL PARAMETERS/ CLEARANCES :**

Sl.	Technical Parameter	Unit	-
1	Type of Switchyard		AIS
2	Nominal voltage class, rms	kV	110
3	Maximum System voltage, rms	kV	123
4	Current Rating	A	1250A
5	Number of phases	Nos	03
6	Symmetrical Short time withstand current	kA/Sec	40 kA for 3 sec.
7	One minute power frequency withstand voltage	kV	230
8	Peak impulse test withstand voltage	kV	550
9	Creepage distance	mm/kV	25
9.1	Phase to Phase	mm	1100
9.2	Phase to Earth	mm	1100
9.3	Phase To Phase Spacing	mm	2800
9.4	Minimum Section Clearances	mm	4000
10	Design ambient Temperature	°C	50

**2.2 STANDARD VOLTAGE LEVELS:**

S.No.	Description	Voltage level
1.	Evacuation and Transmission 110 kV	3 phase, 3 wire 50 Hz, effectively earthed
2.	Station supply	415 V, 3 phase, 4 wire, 50 Hz, effectively earthed.
3.	A.C. Drive motors	415 V, 3 phase, 4 wire effectively earthed

**General Technical Requirement**

**SECTION 3, REV 00**

S.No.	Description	Voltage level
4.	Metering 110 V	110 V, AC PT. voltage
5	Control & protection gear	AC 2 wire from UPS
6.	Panel lighting and space heaters	230V, 1 phase, 2 wires, 50 Hz, A.C. with point earthed.

**2.3 BASIC INSULATION LEVELS**

Sl.No	Nominal voltage kV	BIL kV (peak)
1.	110 kV	550
2.	11 kV	75
3.	400 V	1.1

**[3] GENERAL REQUIREMENT**

**3.1 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE INACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HASBEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.**

**3.2** Life of the Electro-mechanical generating equipment i.e., turbine, generator, transformers, auxiliaries etc. shall not be less than thirty five (35) years.

**3.3** All EQUIPMENTS and type of clamps, fittings hardware, 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.

**3.4 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-1 of Technical specifications. Approval of make of item shall be taken up by vendor from M/s TANGEDCO himself.

### **3.5 COMPLETENESS**

Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

- 3.6** All the equipment, technological structures, pipes, valves, fittings, etc shall be subjected to inspection and testing as per accepted national or international standards and practices. All the components shall be subjected to inspection and testing as per standard practices of the manufacturer prior to offering them for inspection by the Purchaser /his authorized representative.
- 3.7** Suitable working platforms, walkways, ladders lifting tackles and tools required for the above shall be provided.
- 3.8** The fabrication and assembly areas shall be kept clean and free from contamination. During assembly of major components, a polythene covering shall be maintained in position to prevent ingress of dirt, grease, etc from overhead cranes or other equipment.
- 3.9** All equipment shall be visually inspected in the presence of an inspector immediately before closure. A system of physical identification and accountability shall be used to account for all tools, test equipment, shipping blanks and other items used during assembly to obviate the possibility of their being left inside vessels or equipment.

**3.10 CODES & STANDARDS**

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

1. Bureau of Indian Standards (BIS)
2. Indian electricity act
3. Indian electricity rules

**General Technical Requirement**

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4. Indian Explosives Act
5. Indian Factories Act and State Factories Act
6. Indian Boiler Regulations (IBR)
7. Regulations of the Central Pollution Control Board, India
8. Regulations of the Ministry of Environment & Forest (MoEF), Government of India
9. Pollution Control Regulations of Department of Environment, Government of India
10. State Pollution Control Board.
11. Rules for Electrical installation by Tariff Advisory Committee (TAC).
12. Any other statutory codes / standards / regulations, as may be applicable.

Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

1. Japanese Industrial Standards (JIS)
2. American National Standards Institute (ANSI)
3. American Society of Testing and Materials (ASTM)
4. American Society of Mechanical Engineers (ASME)
5. American Petroleum Institute (API)
6. Standards of the Hydraulic Institute, U.S.A.
7. International Organization for Standardization (ISO)
8. Tubular Exchanger Manufacturer's Association (TEMA)
9. American Welding Society (AWS)
10. National Electrical Manufacturers Association (NEMA)
11. National Fire Protection Association (NFPA)
12. International Electro-Technical Commission (IEC)
13. Expansion Joint Manufacturers Association (EJMA)
14. Heat Exchange Institute (HEI)

Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

### **3.11 LANGUAGE**

- a. The tender shall be submitted in English language only.
- b. In all the technical correspondences English shall be used. Warning & safety notice around the plant shall be in English and Tamil.
- c. Plant labels & rating plates and all permanent & temporary notices around the plant shall be in English.
- d. Instruction manuals & training programme shall be in English. The visual display unit outputs given by the computer driven data acquisition system shall be in English only.
- e. If the offer and all documents are not submitted in English, the tender is liable for rejection. Further, in case the tenderer submits documents in any language other than English along with the translation of the same, such translated documents in English shall be submitted duly authenticating that the translation is true and correct to their knowledge and belief in all such pages by the bidder/ all the consortium partners duly affixing their signatures and seals. In case of foreign bidders, this shall be in addition to the attestation by the Consulate of India

functioning in the respective countries. In case such proper authentication for translated documents is not observed, the tender is liable for rejection.

- f. All documents, instructions, catalogues, brochures pamphlets, design data, norms and calculations, drawings, operation, maintenance and safety manuals, reports, labels, on deliveries and any other data shall be in English Language.
- g. All correspondence between TANGEDCO and the Contractor shall be in English language.
- h. However, all signboards required to indicate "Danger" and/or security at site and otherwise statutory required shall be in English, Tamil & Hindi languages.

### **3.12 TECHNICAL AND ENGINEERING SERVICES**

Technical Services to be provided by the Contractor shall generally include the following amongst others:

- a) Material testing, if necessary.
- b) Basic design/drawings and layout engineering
- c) Detail design/drawings and engineering
- d) Drawings/data for carrying out Plant Engineering and detail design including design modification & model testing/ CFD analysis/drawings of civil, structural and services, wherever necessary.
- e) Technical services relating to planning, procurement, manufacturing inspection, expediting, packing, shipping, storing, etc.
- f) Project management services and complete feedback data and information to TANGEDCO/Purchaser for the same, for the Contractor's scope of supply and services.
- g) Training of TANGEDCO/Purchaser's personnel.
- h) Consultancy services, if any, obtained by the Contractor from elsewhere
- i) Technical consultation/liaison/guidance relating to detail design a plant engineering by his Sub-Contractors.
- j) Supplier's co-ordination relating to site work and other engineering work.
- k) Total supervision of dismantling, repair, civil engineering work & erection including specialised erection services.

- l) Start-up trial runs, and- commissioning services.
- m) Demonstration of performance guarantee tests with the commissioning engineers/specialists.
- n) Quality control and adherence to the time schedule control of site work and other Indian works. Time bound project co-ordination relating to customs clearance, transportation, insurance, claim settlement, inspection, construction planning and scheduling dismantling repair & erection planning field construction engineering, cold tests, start up, trial run, commissioning and performance guarantee tests. The contractor shall bring and associate his own and /or his sub-contractor's specialists for the performance of the above mentioned functions.
- o) Clearance of installations from the statutory and other concerned authorities on behalf of TANGEDCO/Purchaser, The Contractor shall also assist in preparing application forms, providing necessary drawings, documents test certificates etc including necessary co-ordination with statutory and other concerned authorities.

The Contractor shall be responsible for supply of all the drawings and technical documents & information in respect of the plant & equipment, commissioning spares and also for recommended spares for operation and maintenance. The Contractor shall deliver the drawings, technical documents and information to TANGEDCO and his authorised agency.

### **3.13 APPROVAL BY TANGEDCO**

- a. Drawings and documents as per this contract shall be subject to the review and reference of TANGEDCO. Documents and drawings as mentioned in this contract shall be subject to the approval of TANGEDCO.
- b. All changes from the approved drawings/documents shall be subject to the prior approval of TANGEDCO.
- c. All Sub-Contractors and sub-suppliers for raw materials testing, design and engineering, manufacture, supplies, construction and erection work and any other work/services covered under the Contract shall be subject to the written approval of TANGEDCO.

- d. While the Contractor shall make/execute/perform supplies, work and services in terms of the Contract, TANGEDCO shall have the right to check and approve design, type, quality, quantity, materials and workmanship of any or all items of supplies, work and services where considered necessary by TANGEDCO to ensure that supplies, work and services made/executed/ performed by the Contractor are in accordance with the provisions of this Contract.
- e. The Chief Project Manager of Contractor who shall be in overall charge of the Project and Site Manager at site shall be appointed in consultation with TANGEDCO.
- f. Detailed assignment schedules of foreign Experts/ Specialist for rendering technical services shall be submitted by the Contractor for the approval of TANGEDCO within six months from the effective date off contract. The biodata of key personnel shall be submitted within two months of the effective date of contract and for others six months before their deputation.
- g. To enable TANGEDCO to accord approval and to review documents and drawings, the Contractor shall submit back-up data/drawings/basic calculations/assumptions as may be required by TANGEDCO.
- h. Where approval of TANGEDCO is required or implied but is not specifically provided for elsewhere in this Contract, such approval shall also come within the purview of this schedule.
- i. Approval by TANGEDCO in terms of this schedule shall not relieve the Contractor of any of his obligations under the Contract. TANGEDCO shall approve or refuse approval within 30 (thirty) days from the date of receipt of request with supporting documents.
- j. The approval requested by the Contractor shall not be withheld unreasonably by TANGEDCO. All requests for approval shall be accompanied by fully supporting documents, otherwise it shall not be considered as a request.

#### **[4] INSPECTION AND TESTING**

##### **4.1 INSPECTION**

#### **4.1.1 GENERAL**

- a) Manufacturing progress review, inspection & testing of equipment covered under the technical specification shall be carried out by the Purchaser at the manufacturers' works/premises prior to dispatch to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.
- b) These instructions are in addition to provisions laid down in other tender documents of the Purchaser.

#### **4.1.2 INSPECTION & TESTING STAGES AND FINALISATION OF QUALITY ASSURANCE PLAN (QAP)**

- a) Within 12 weeks of the award of contract the Contractor shall furnish the quality assurance plan as per proforma given to successful tenderer for electrical equipment. separately with suggestive stages and hold points for undertaking inspection and testing by the Purchaser/TANGEDCO. Total list of plant & equipment of the order shall be submitted to the Purchaser/TANGEDCO prior to submission of QAP
- b) After receipt, scrutiny and rendering into acceptable mode of above documents, a mutually agreed programme of inspection & testing of equipment shall be finalized with the Contractor by the Purchaser/ TANGEDCO.
- c) Inspection & testing of plant & equipment shall be undertaken by the Purchaser / TANGEDCO after finalization & approval of QAP.

#### **4.1.3 RESPONSIBILITY FOR INSPECTION**

- a) Any inspection by the Purchaser does not replace the responsibility of quality assurance and quality control functions, as expected of the Contractor to be performed by him for supply of plant & equipment as part of the contractual obligations. As such, any approval which the Inspecting Engineer of the Purchaser may have given in respect of plant and equipment and other particulars and the work or workmanship involved in the contract (whether with or without test carried out) shall not bind the Purchaser to accept the plant and

equipment, should it on further test at site be found not to comply with the requirements of the contract.

b) The Contractor is to meet the inspection & testing requirements for the equipment coming under statutory regulations e.g. weights & measures, safety, IE rules, etc. and submit certificates and documents from appropriate authority to Inspecting Engineer for the same.

#### **4.1.3 EXTENT OF INSPECTION**

a) The extent of inspection by the Purchaser shall vary from equipment to equipment as per design requirements.

b) However, indicative extent of inspection for electrical equipment is furnished below.

c) Extent of inspection to be carried out shall be finalized with the Contractor after award of the contract on the basis of scope of supply, technical specification and approved GA drawings. However, in case of similar bulk manufactured items, methods of sampling for inspection of different lots shall be governed by relevant Indian or international standards.

d) In case of critical components, the Purchaser reserves the right to undertake 100% inspection.

e) .Categories of Equipment :

1. Bought out items.&

2. Final Inspection & testing

f) Extent of Inspection : (as applicable from equipment to equipment)

i) BOUGHT-OUT ITEMS

Following standard bought-out items shall be accepted on the basis of manufacturers' test certificates:

- LV current transformers

- Standard AC motors

- AC /DC DBs

- Push button station in manufacturer's' standard enclosure

- LT power, control & instrumentation cables and cable termination / jointing kits

- Starters in manufacturer's standard enclosure
  - Light fittings
  - Field instruments
  - Conduits
  - Cable trays
- ii) FINAL INSPECTION & TESTING:
- Verification of test certificates
  - Visual & Workmanship
  - Dimensional
  - Witnessing of routine tests as per relevant standards. Manufacturers' test certificates for type test to be submitted for verification.
  - Witnessing of proto-type tests, as applicable.

#### **4.1.5 TESTS, TEST CERTIFICATES AND DOCUMENTS**

- a) For each of the items being manufactured, following test certificates and documents (as applicable for each of the equipment) in requisite copies shall be prepared and submitted to the Inspecting Engineer for scrutiny & records.
- i) Materials identification & physical and chemical test certificates for all materials except IS:2062 -1992 and FG 150 IS:210-1978 materials used in manufacture of the equipment.
  - ii) Welding procedures and welder's qualification test certificates, wherever applicable.
  - iii) Routine/type/calibration/acceptance/special test certificates for electrical items.
  - iv) Surface preparation and painting certificates.
  - v) Certificates from competent authority for the items coming under statutory regulations.
- b) The Contractor shall be required to produce the specimen and test pieces on which tests were carried-out by his sub-contractors and if called for, samples and specimen shall become the Purchaser's property.
- c) Where facilities for testing do not exist in the Contractor/sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the contractor/sub-contractor in presence of Inspecting Engineer and sealed

samples shall be sent to any approved laboratories for necessary tests at Contractor/sub-contractor's cost.

d) The Purchaser/TANGEDCO shall have the right to be present and witness all tests being carried out by the Contractor/sub-contractor at their own laboratory or approved laboratories. Also, the Purchaser/TANGEDCO shall reserve the right to call for confirmatory test on samples, at his discretion.

e) Should the result of tests not come within the margin specified, the tests shall, if required, be repeated at Contractor's cost without any liability to the Purchaser

#### **4.1.6 METHOD OF GIVING INSPECTION CALLS**

Inspection calls shall be given by the Contractor. All calls shall accompany four sets of relevant test certificates and inspection report of the Contractor/ sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP.

## **4.2 TESTING**

### **4.2.1 GENERAL**

a) Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC/VDE/DIN/BS.

b) All routine tests shall be carried out at manufacturer's works in presence of purchaser or his representative.

c) The tenderer shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates for similar equipment is not available, the same shall be conducted in presence of purchaser or his representative if purchaser so desires, without any financial implications to purchaser. Heat run test based on type test certificate of similar transformer is acceptable.

d) The site tests and acceptance tests to be performed by contractor are detailed below.

e) The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

#### **4.2.2 SITE TESTS AND CHECKS**

- a) All the equipments shall be tested at site to know their condition and to prove suitability for required performance.
- b) The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site.
- c) In addition to tests on individual equipment some tests/ checks are to be conducted / observed from overall system point of view. Such checks are highlighted under 'Miscellaneous tests' but these shall not be limited to as indicated and shall be finalized in consultation with TANGEDCO before charging of the system.
- d) The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.
- e) All checks and tests shall be conducted in the presence of TANGEDCO's representative and test results shall be submitted in six copies to TANGEDCO and one copy to Electrical Inspector. Test results shall be filled in proper proforma.
- f) After clearance from Electrical Inspector system/ equipment shall be charged in step by step method.
- g) Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging, are to be brought by the contractor.

#### **4.2.3 SITE TESTS**

The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to the following:

##### **a) TRANSFORMER**

1. IR test on each winding to ground and between windings.
2. Turns ratio test on each tap.

3. Polarity and vector group test.
4. Measurement of winding resistance.
5. IR, wiring and operational tests on all control devices in control cabinet, oil level indicator, winding and oil temp. indicators, cooling fan etc.
6. Checking of Earthing with respect to transformer tank (flexible from top cover to tank) other parts, neutrals and tank to electrodes of LAs (for LAs located near to transformer).
7. Testing of buchholz relay for alarm and trip conditions.
8. For bushing CTs, tests applicable shall be as for current transformers.
9. Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.
10. Check insulators for cracks.
11. Checking for oil leakage and arresting of leakages (if there)
12. Checking of operation of all valves.
13. Checking for open position of all the valves (except drain and filter valves).
14. Filtration of oil by using line filter, vacuum pump, and heater set.
15. BDV test on oil samples from top and bottom.
16. Checking of oil for acidity, water content, tan delta etc. as per IS 335.
17. Measurement of magnetizing current and no load loss.
18. Measurement of PI value.
19. Checking of silica gel breather.
20. Checking of noise level at no load and at full load.
21. Checking of air circulation conditions for indoor transformers.
22. Conducting magnetic balance test
23. Checking of other points given in manufacturer's commissioning manual.
24. Back charging of the transformer and checking of voltages at different tap positions.
25. Tan delta Test and SFRA test at site

**b) CURRENT TRANSFORMER**

1. IR test on each winding, winding to earth and between windings.
2. Checking of winding ratios by primary injection set.
3. Polarity check on each winding.

4. Continuity check for all windings.
5. Check for connections to correct taps.
6. Measurement of knee point voltage and secondary winding resistance for the CTs used for differential protection.
7. Checking of continuity and IR values for cables from CT to Marshalling box.
8. Checking tightness of Earthing connections.
9. Check output after loading of the main circuit.
10. Tan Delta Test.

**c) POTENTIAL TRANSFORMER**

1. IR test of primary winding by HV megger between windings and earth
2. IR test of secondary winding by LV megger between windings and winding to Earth.
3. Checking of voltage ratio.
4. Verification of terminal markings and polarity.
5. Checking of continuity and IR values for cables from PT to Marshalling Box.
6. Checking tightness of Earthing connections.
7. Checking of insulator for cracks.
8. Check output on charging of the system with connected meters/relays.
9. Tan Delta Test.

**d) ISOLATOR / DISCONNECTING SWITCHES**

1. IR test by HV Meggar on main poles.
2. IR test on control circuits.
3. Measurement of Contact resistance for all three phases.
4. Functional checking for electrical and manual operation.
5. Checking of interlocking with earth switch and as per write up and checking of earth switch operation.
6. Checking of operation of earth switch.
7. Setting and checking of auto trip operation of motor on complete close / open position of isolator.
8. Testing of overload relay of motor.

9. Checking for remote operation.
10. Checking of operation on minimum and maximum specified voltages (local as well as remote).
11. Checking tightness of Earthing connections.
12. Checking of insulators for cracks.

**e) LIGHTNING ARRESTOR**

1. Continuity check (for metal oxide type only).
2. Check for connection to ground.
3. Check insulators for cracks.
4. Check reading of leakage current.
5. HT and IR test of each element.

**f) INSULATORS**

1. Checking of tightness of connection.
2. Check for minor damage / cracks after cleaning.
3. Verification of number of disks as per drawing.
4. Check for Creepage distance on one type of each set.
5. Check heating at termination point during shutdown.

**g) NGT**

1. Measurement of resistance
2. IR test by HV megger between terminal and earth.
3. Checking of earth connection for terminal and for body
4. Check for isolator operation and continuity of aux. contacts (if applicable)
5. Check for temp. rise of enclosure and current flow in the resistances.

**h) LT SWITCHGEAR**

1. IR test
2. HV test with 1.1 kV Meggar
3. Functional test for all feeders
4. Testing of all meters
5. Checking and calibration of overload relays and protective relays as per supplier's commissioning manuals.

6. Check operation of contactors from local and remote points
7. Checking of interlocking between incomers/bus coupler and other feeders.
8. Test to prove interchangeability of similar parts

**i) PDB/DCDB**

1. IR test before and after HT test
2. HV test by 1.1 kV megger
3. Checking for functions of components for each module
4. Checking for interchangeability of similar components
5. Checking of tightness of earth connection.
6. Testing and calibration of all indicating meters
7. Check output of each feeder after energization.

**j) AC MOTORS**

1. IR test of stator and rotor windings.
2. Check tightness of cable connection
3. Winding resistance measurement of stator and rotor.
4. Check tightness of earth connections.
5. Check space heaters and carryout heating of winding (if required)
6. Check direction of rotation in decoupled condition during kick start
7. Measure no load current for all phases.
8. Measurement of temperature of body during no load and load conditions.
9. Check for tripping of motor from local/remote switches and from electrical/ technological protection including differential protection.
10. Checking of vibration.
11. Checking of noise level.
12. During load running, measurement of stator and bearing temperatures (if applicable) for every half an hour interval till saturation comes.
13. Checking tightness of foundation bolts.
14. Check continuity of temp. detectors.
15. For actuator drives following shall be checked/tested :
  - Visual and dimensional.
  - IR and operation of limit switches.
  - Winding resistance.

**k) UNINTERRUPTED POWER SUPPLY**

1. Visual check.
2. IR value by megger.
3. Current limit test.
4. Ripple test.
5. Supply variation.
6. Functional test.
7. Capacity test with respect to time.

**l) CABLES & CABLES SUPPORTING STRUCTURES**

1. Checking of continuity/phasing and IR values for all the cables before and after HV test.
2. HV test and measurement of leakage current after termination of cable kits (for HT cables).
3. Checking of earth continuity for armor and fourth core (if applicable).
4. Check for mechanical protection of cables.
5. Check for identification (tag number system) distance placement of cable marker, cable joint etc. as per the cable layout drawing.
6. Check Earthing of cable structures.
7. Check clearances from ventilation duct and light fittings for cable structures.
8. Check proper fixing of cable structures.

**m) INDOOR LIGHTING**

1. Check dressing of cable.
2. Measurement of lux level at various places.
3. Check accessibility for replacement of lamps.
4. Checking for black spots or poor visibility near operating and indicating equipments.
5. Check for mechanical protection of cables.
6. Checking for adequacy of emergency DC light.
7. Checking for starting system of periphery lighting.
8. Check for auto switching of battery supply on failure of AC.
9. Checking of Earthing of light panel, socket boards, light fittings.

10. Checking of type of fittings with respect to specification at various locations.
11. Check adequacy of support of fittings.
12. Check water tightness of outdoor located panels.

**n) EARTHING**

1. Check tightness of all earth connections
2. Check earthing of all metallic equipments, cable trays, Busbar supporting structures, yard fencing steel structures of yard, rails, gates, building column (if steel) all elect. equipments, gas/oil/water pipe lines etc. as per the drawing / specification
3. Measurement of earth resistance for each electrode.
4. Measurement of total earth resistance.
5. Measurement of earth loop resistance for E/F path of biggest LT drive.

**o) CONTROL, RELAY & METERING PANELS**

1. IR value test by megger
2. Checking of control cable connection.
3. Operational test of all components mounted on control panel.
4. Testing and calibration of indicating meters
5. Testing of all relays including auxiliary relays for their pick up- drop values, operation at all taps (current, voltage and time) etc. as per the manufacturer's commissioning manuals with the help of relay testing kits.
6. Setting of relays as per approved setting table and checking its operation for one below and one upper settings, in the scheme.
7. Measurement of current and voltage in relay operating coils by secondary injection in CT and PT circuit at switchboard.
8. Measurement of current and voltage in relay and meter circuits during loading of the primary circuit/system
9. Testing of all schemes for their functions as per approved drawings
10. Checking stability of differential protection schemes
11. Checking inter changeability of similar equipments
12. Verification of accessibility of all operating points including resetting knob of relays

13. Check operation of each annunciation facias, operation of bell/hooter etc. and sequence of the system
14. Check operation of relays at minimum/maximum control voltage as per the specification
15. Integrated testing of protective relays for operation of master trip relays and tripping of breakers from Operation of master trip relay
16. Check dressing of cables, sealing of openings in gland plate and for provision of double compression glands
17. Check earthing connection of panels, fixing of panels and openings from side and bottom.
18. Checking and adjustment in tri-vector meters as per the manufacturer's instructions.

**p) MISCELLANEOUS**

1. Checking of continuity of the system
2. Checking of phase sequence from overhead line to consumer end
3. Checking safe accessibility of all operating points
4. Check availability of emergency lighting
5. Check availability of control/aux. supply
6. Ensure availability of first aid box, firefighting equipments, earth discharge rods, rubber mats, rubber glove
7. Check working of ventilation system for battery room - transformer room etc.
8. Check proper covering of cable channels.
9. Placement of shock treatment chart, danger boards, provision of boards indicating 'Man on Work, Do not switch ON', 'Do not switch OFF', 'Earthed', etc.
10. Check proper dressing of cables, mechanical protection of cables, placement of cable markers
11. Check sealing of all cable openings including conduit opening with fire resistance material
12. Check sealing of all openings at bottom of elect. panels.

## **[5] PAINTING**

### **5.1 GENERAL**

- a) The primers & finishing paints will conform to latest Indian Standard or equivalent international standards. There shall be of approved quality and shade.
- b) General precautions for painting such as preparation of surfaces, application of paints, inspection and testing etc. will be as per relevant clause of IS: 1477 (Part I & II) and shall be followed, wherever possible.
- c) General compatibility between primer and finishing paints recommended by the paint manufacturer, supplying these paints shall be followed.
- d) General compatibility between successive coats must be ensured.
- e) Unless otherwise specified, the general color scheme for finishing coats for different types of equipment and pipelines as per requirement of the Purchaser are to be followed. The color schemes, however, may be changed, if necessary, by the Purchaser at any stage before the start of the painting of the equipment.

### **5.2 PAINTING INSTRUCTIONS**

- a) In general, unless otherwise specified, all plant and equipment & pipelines will be given one coat of antirust primer, lacquers, etc. at the supplier's works after completing surface preparation to remove grease, rust, scales and other foreign materials. The second coat of antirust primer will be applied immediately after erection after completing requisite surface preparation) followed by two coats of finishing paint of approved quality & shade.
- b) Technological structures, crane girders & other structures shall be given one coat of primer during manufacturer & one coat of primer after erection followed by two coats of finishing paint.
- c) For equipment where original colour as per supplier's practice is desired, both primer & finishing coats will be applied at supplier's works before dispatch of equipment.

- d) Structures embedded in concrete shall have no shop painting applied. The portion of the column that is to be embedded in concrete shall be given a coat of Portland cement slurry after thoroughly cleaning the surfaces from mill scale, grease & oil immediately after fabrication.
- e) The portion of the structures embedded underground shall be given two coats of red leadg raphite primer at shop and finished with two coats of bituminous black paint of approved quality.
- f) Machined/plained surfaces shall be coated with while lead and tallow before dispatch or before being put into open air & covered with gunny cloth.
- g) Surfaces to be site welded shall have no shop paint applied within 100mm of welding zone. After site welding normal painting application will be followed.
- h) Areas which become in-accessible after assembly shall be painted before assembly.
- i) Cables & other electrical accessories shall have adequate antirust protection.
- j) Chequered plates shall be given primer coats only.
- k) The phosphate coated surface shall have one coat of baking based and two coats of finished paint of amino alkyd resin stone enamel.
- l) External surface of pipe fittings shall be thoroughly cleaned by wire brushing and given two coats of red oxide zinc chromate primer at supplier's works & two coats of final synthetic enamel paint after erection.
- m) The equipment which are to be dispatched in knocked down condition and require assembling at site, shall be given two coats of rust and corrosion preventive primer and one coat of synthetic enamel paint of approved quality and shade. After assembly at site, such equipment shall be given one final coat of synthetic enamel paint.
- n) The equipment which can be sent as a single block unit duly shop assembled, shall be given full application of paint i.e. two primer coats of rust and corrosion preventive primer and two finish coats of paint of approved quality and shade as per relevant Indian Standards/equivalent international standards.

- o) All painting shall be carried out by brushing or roller application with prior permission of the Purchaser.
- p) All metal parts not accessible for painting shall be made of rust and corrosion resisting materials. Interiors of equipment will be suitably coated with anti-rust compounds.
- q) The fasteners shall not be painted. These will be dispatched with application of anti-rust compound.
- r) Any special painting requirement indicated on the Contractor's drawings by the Purchaser during approval stage shall be binding.

## **5.2 SURFACE PREPARATION AND ENVIRONMENTAL CONDITIONS**

- a) All surfaces to be painted shall be thoroughly cleaned of dirt, grease, rust & mill scale.  
Removal of rust & scale shall be by hand brushing, power driven wire brushes or by sand blasting, as the surface condition/service condition warrants.
- b) The paint shall be applied on the metallic cleaned surface after it is perfectly dry but not later than 3 hours after cleaning of the surfaces. Reasonable time gap should be allowed between any two consecutive coats of primer or finishing coats.
- c) Surfaces coming in contact with acid & acidic fumes alkalis, soda, detergents etc shall be cleaned thoroughly to get complete metallic surface as per IS; 1477 Part I & II or BS 4232-1967. After sand blasting the surface shall be cleaned with cotton rags, soaked in benzene, to remove fine rust, grease, etc. No sand blasted surface shall be exposed to weather for more than 3 hours.
- d) The choice of primer & finishing paint will depend on the environmental condition to which the plant & equipment & pipelines are exposed to.
- e) Paints are to be applied on dry surface only under agreeable weather conditions. Painting in damp & foggy weather conditions will not be permitted.
- f) For a selected primer the method of surface treatment best suited for that primer & suggestion of paint manufacturer shall be obtained and followed.

- g) Zinc rich primer paints which have been exposed for a long time before the finishing coat is applied shall be washed down thoroughly to remove soluble zinc salt deposit.
- h) The recommendation of paint manufacturer shall be forwarded to the Purchaser for approval.

## **5.2 PRIMER PAINT**

- a) In general, two coats of primer paints conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces, except noted otherwise.
- b) Where equipment is to be finish painted for dispatch, both coats will be applied before finishing coats at supplier's works.
- c) Where equipment warrants finishing coat after erection, one coat will be applied just after manufacture at supplier's works and the second coat just after erection at site after surface cleaning.
- d) Equipment on which primer coat has been damaged due to prolonged exposition at site, final erection or transport, shall be given two coats of primer at site before applying finishing coats. Before applying paint the surface will be thoroughly cleaned by sand paper.
- e) The primer applied should be compatible in quality and colour schemes with the subsequent finishing coats.
- f) Unless stated otherwise, the following primer paints shall be used depending upon the exposition and environmental condition to which the plant & equipment, structures & pipelines are exposed to :
  - Aluminium zinc oxide - conforming to IS;2931
  - Red oxide zinc chromate - conforming to IS;2074
  - Heat resistant aluminum - conforming to IS:161 primer paint
  - Air drying chemical resistant paint
  - Epoxy resin paint (cold cured) -
  - Poly urethane paint
  - Chlorinated rubber based conforming to DEF-1402, Ministry of Defense

## **5.3 PRIMER PAINT**

- a) Two coats of finishing paint compatible with the primer and conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces unless mentioned otherwise.
- b) Unless noted otherwise, the following finishing paints will be applied on plant & equipment, structure & pipelines depending upon the exposition and environmental conditions to which the plant & equipment, structures & pipelines are subjected to:
- Synthetic enamel conforming to IS; 2932 exterior type
  - Epoxy based finishing paint -
  - Heat resistant silicon based Aluminium paint IS: 161
- c) The finishing paint shall be of approved colour. The undercoat shall have different tinge to distinguish from the finishing paint.
- d) The surfaces of the equipment on which finishing coats of paint has been damaged due to prolonged exposition at Contractor's work, erection site, during transport, storage or final erection shall be thoroughly cleaned & touched up with the same paint as applied previously.

### **5.3 THICKNESS OF COAT OF PAINT**

- a) A single coat of paint when dry should have a thickness of 25 to 30 microns (0.025 to 0.030 mm) or 1 mil to 1.25 mils.
- b) Total thickness of 4 coats (2 primer coats + 2 finishing coats) should have thickness of 100 to 125 microns (0.100 to 0.125 mm) or 4 to 5 mils.
- c) In case of bituminous aluminum gilsonite based paint 3 coats are to be applied. The total thickness of 3 coats will be not less than 100 microns (0.100 mm) or 4 mils.
- d) Immediately following the award of the Contract, the Contractor shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for one section shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility.

## **[6] GENERAL REQUIREMENT**

### **6.1 GENERAL**

- a) Name of coordinators with address, telephone/FAX numbers for all sub-contractors, pertaining to electrical job.
- b) List of equipment/tools and manpower proposed to be arranged for installation erection and site handling of the equipment.
- c) Name of site in-charge with office/ organization and date of opening of site office.
- d) Quality control manuals
- e) Detailed list of drawings and documents containing information on current state of the project.
- f) Monthly progress report furnishing status of
  - Planning
  - Manufacture
  - Transport
  - Erection
  - Testing & commissioning

### **6.2 FOR APPROVAL**

#### **A. CALCULATIONS**

1. Relay settings with calculations and graph for justification of all relay settings (current, voltage and time).
2. Calculation to justify generator CT/PT parameters like VA burden, knee point voltage etc. for all cores.
3. Calculations for Required battery capacities of the UPS system.
4. Calculations for voltage drop and short time rating of cables to prove adequacy of sizes.
5. Calculation for Neutral grounding transformer and secondary resistance.
6. Calculation of lux levels of Control Room, Machine hall and other floors
7. Calculations for short time withstand of transformers.

8. Calculations for design of supporting structures for outdoor switchyard regarding wind pressure, short circuit forces etc.

**B. OTHERS**

1. Single line diagram indicating transformers, breaker, CT/PT, all relays, meters, LA, cable sizes, details of CT/PT ratio, VA burden, V<sub>k</sub> value, type and make of all relays, their range, nominal and short time ratings of bus bars, etc. for all equipment.
2. Front view and GA diagrams for all panels.
3. Control and schematics drawings for local/remote control/protection for each equipment and drives.
4. Drive list.
5. Synchronization schemes.
6. Auto change over arrangement.
7. Logic diagrams for start/stop of various mechanism/drives.
8. Lighting layout for Control Room and other areas. Type of fittings, wiring arrangement, switching of fittings and single line diagram from board to fittings.
9. Details of protection logic (class A,B&C tripping) indicating list of electrical and mechanical protection leading to tripping of turbine generator, field breaker, etc.
10. Equipment Earthing layout drawing
11. Electrical equipment layout for all electrical premises.
12. Cable structure layouts with size of structures for gallery and cable channels of different places
13. Sequence of inspection plan and despatch of materials to site.
14. List of drawings, numbering system, size, proposed date of submission (To be submitted just after LOI).
15. Installation drawings of all equipment with
  - Layout of equipment
  - Layout of Cabling
  - Illumination drawings
  - Earthing Layout.

### **6.3 FOR INFORMATION**

1. Details of painting for all equipment
2. Bus wire arrangement for control/signal/annunciation and heater supplies of control panels and switch boards.
3. Cable schedule indicating type of cables, from to via. route, total length, size of each cable and a final summary sheet indicating total requirement of all types of cables (for control and power both).
4. Core wise control cable termination details indicating ferrule no./terminal block no. for each cable/each equipment.
- 5 Internal wiring diagrams for all panels.
6. VI characteristics and RCT values of CTs used in differential protection.
7. Cable layout drawings.
8. Technical particulars of all LT motors and recommended protection.
9. Catalogues for each type of equipment, relays, meters etc.
10. Installation and commissioning manuals for each equipment, relay etc.
11. Operation and maintenance manuals indicating trouble shooting procedure for all equipment.
12. Type test certificates for all the major equipment.
13. Details of test results conducted at works for all equipment in bound Volume
14. Details of test results conducted at site for all equipment in bound Volume
15. Spare part list number and ordering procedure for all recommended spares.
16. Details of transport arrangement and maximum size of transportable section (weight and overall dimensions).
17. Details of agency proposed to be fixed for doing erection commissioning job.
18. Panel wise bill of material indicating type make and brief technical particulars of all items/ accessories mounted on the panels.
19. Overall GA of all the panels/equipment
20. Fixing details of all the panels/equipment, supporting structures, etc.
21. Heat loss for each equipment.

22. Static and dynamic loading of each equipment
- 23 Floor cutouts and wall opening details for cables bus duct, air conditioning ducts, light conduits, exhaust fans etc.
24. Details and location of various inserts base plates, bolts etc. required to be provided for support of cable structure, bus duct electrical panel, etc.
25. Conduit layout drawing indicating type, size, length and locations of conduits required to be placed in RCC wall/floor, brick wall.
26. Technical data sheet for each type of motors and characteristic curves for protection settings.
27. As built drawings incorporating site changes along with soft copies in CD.

**SECTION IV**

**GUARANTEED AND TECHNICAL PARTICULARS**

1. Manufacturer's Name & address
2. Particulars of raw material
  - 2.1 Aluminium
    - a) Min. purity of aluminium %
    - b) Max. Copper content %
  - 2.2 Steel wires/ Rods
    - a) Carbon %
    - b) Manganese %
    - c) Phosphorus %
    - d) Sulphur %
    - e) Silicon %
  - 2.3 Zinc- Minimum Purity %
3. Aluminium Strands after stranding
  - 3.1 Diameter
    - a) Nominal mm
    - b) Maximum mm
    - c) Minimum mm
  - 3.2 Min. breaking load of strand after stranding kN
  - 3.3 Max. resistance of 1m length of strand at 20° C
4. STEEL STRANDS AFTER STRANDING
  - 4.1 Diameter
    - a)Nominal mm
    - b)Maximum mm
    - c)Minimum mm
  - 4.2 Min. breaking load of strand Kn
  - 4.3 Galvanizing
    - a) Min. weight of zinc coating per sq.m of uncoated wire surface gm.
    - b) Min. no. of dips that the galvanized strand can withstand in the standard preece test
    - c) Min. number of twist to be withstood in torsion test when tested on a gauge length of 100 times diameter of wire Nos.

5. ACSR CONDUCTOR

- |     |   |       |
|-----|---|-------|
| 5.1 | Minimum UTS   | kN    |
| 5.2 | Lay Ratio of conductor  |       |
| a)  | Outer Steel layer   |       |
| b)  | Aluminium - 12 wire layer   |       |
| c)  | Aluminium 18 wire layer   |       |
| d)  | Aluminium 24 wire layer   |       |
| 5.3 | DC resistance of ACSR at 20°C                                       | Ω     |
| 5.4 | Min. corona extinction voltage (dry)                                | kV    |
| 5.5 | RIV at 1 MHz across 300-ohm resistor at 305 kV under dry conditions |       |
| 5.6 | Standard length of conductor in one drum                            | m     |
| 5.7 | Direction of lay for outside layer                                  | -     |
| 5.8 | Linear mass of conductor  | mm    |
| a)  | Standard  | kg/km |
| b)  | Minimum   | kg/km |
| c)  | Maximum   | kg/km |
| 6.  | No. of cold pressure but welding equipment available at works       |       |

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**ANNEXURE-A**

**COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION**

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature

**ANNEXURE - B**

**SCHEDULE OF TECHNICAL DEVIATIONS**

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

<u>S.No.</u>	<u>Section/ Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
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**Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.**

Date:

Tenderer's Stamp & Signature

ACSR CONDUCTOR - TYPE: MOOSE specifications

Standards

Conformity of the specification for Aluminium conductors for overhead transmission purposes\*

as per IS:398 (Part 5):1996 latest

ISI Marked (If "Yes" Select 2 If "No" select 1)\* 2

BIS License number - Must Declare (for Non ISI Marked write NA)\*

Govt. Organization with which seller is registered\* NA

Aluminium wires :Properties and characteristics\* as per IS:398 (Part 5):1996 latest

Steel Wire: Properties and characteristics as prescribed for regular strength steel wire\*

as per IS:398 (Part 5):1996 latest

Testing and Inspection protocol\* as per IS:398 (Part 5):1996 latest

Type Test, Acceptance test, Routine Tests parameters, test methods and requirements\*

as per Cl. 14 of IS:398 (Part 5):1996 latest

Packing and marking\* as per Section 4 of IS:398 (Part 5):1996 latest

Steel Drums for packing of finished conductor\* as per OEM's drawing

Wooden Drums for packing of finished conductor\* as per OEM's drawing

Price variation\* Not applicable

Agreed to obtain approval of manufacturing quality plan from buyer before commencement of

manufacturing and agreed to follow the same\* Yes

All the Annexures attached above are seen and under stood\* Not applicable

Transmission Line Parameters

Voltage rating\* 400KV

Bundle Configuration\*

Construction

Shape of conductor\* Stranded

No. of Aluminium wires in conductor (in Nos.)\* 54

Aluminium wire diameter, Nominal (in mm)\* 3.53 (Minimum: 3.51 mm, Maximum: 3.55 mm)

No. of Steel wires in conductor (in Nos.)\* 7

Steel wire diameter, Nominal (in mm)\* 3.53 (Minimum: 3.47 mm, Maximum: 3.59 mm)

Steel Core (in Nos.)\* 1

No. of of wires on 1st steel layer (in Nos.)\* 6

No. of of wires on 1st Aluminium layer (in Nos.)\* 12

No. of of wires on 2nd Aluminium layer (in Nos.)\* 18

No. of of wires on 3rd Aluminium layer (in Nos.)\* 24

Chemical Composition - Aluminium

Minimum Purity of aluminium (in %)\* 99.5

Maximum copper content (in %)\* 0.04

Chemical Composition - Steel wires / Rods

Carbon (in %)\* 0.50 to 0.85  
Manganese (in %)\* 0.50 to 1.10  
Phosphorous (in %)\*  $\leq 0.035$   
Sulphur (in %)\*  $\leq 0.045$   
Silicon (in %)\* 0.10 to 0.35  
Minimum purity of zinc (in %)\* 99.95  
Breaking load

Minimum breaking load of strand: Aluminium: Before stranding (in KN)\* 1.57  
Minimum breaking load of strand: Aluminium: After stranding (in KN)\* 1.49  
Maximum Resistance of 1 m length of Aluminium strand at 20 deg. C (in Ohm)\* 0.002921  
Minimum breaking load of strand: Steel: Before stranding (in KN)\* 12.86  
Minimum breaking load of strand: Steel: After stranding (in KN)\* 12.22  
Method for tensile testing of steel wire\* as per IS:1521:1972 latest  
Galvanizing

Zinc used for galvanizing shall be electrolyte high grade zinc\* as per IS:209:1992 latest  
Methods for testing uniformity of coating of zinc coated articles\* as per IS:2633:1986 latest  
Hot-Dipped Galvanized Coatings on Round Steel Wire\* as per IS:4826:1979 latest  
Method for determination of mass of zinc coating on zinc coated iron and steel articles\*

Minimum weight of zinc coating per Sq.mm (in gm)\* ~~260~~ 260  
Minimum number of dips that the galvanised strand can with stand in the standard preece test\*  
2 of one minute and 1 of half minute

Recommended Practice for Hot-Dip Galvanizing of Iron and Steel\*  
as per IS:2629:1985 latest

Minimum no. of twists in gauge length equal 100 times the dia., of wire which the strand can  
withstand in the torsion test (after stranding)\* 16  
Stranded Conductor

Overall diameter (in mm)\* 31.77  
Sectional area of aluminium (in Sq.mm)\* 528.5  
Total sectional area (in Sq.mm)\* 597  
Minimum UTS of the conductor (in KN)\* 161.2

Maximum DC resistance of the conductor at 20 deg. C (in Ohm/Km)\* 0.05552  
Standard Length

Standard length of the conductor (in m)\* 2100 $\pm$ 5%  
Linear mass of the conductor, Standard (in Kg/Km)\*  
2004 (Minimum: 1969 Kg/ Km, Maximum: 2040 Kg/ Km)

Lay Length of Outer Steel Wire  
Direction of lay of outer layer\* Right hand

Minimum Lay length, 1st Steel layer (in mm)\* 16 to 18

Minimum Lay length, 1st Aluminium layer (in mm)\* 12 to 14

Minimum Lay length, 2nd Aluminium layer (in mm)\* 11 to 13

Minimum Lay length, 3rd Aluminium layer (in mm)\* 10 to 12

Workmanship

Aluminium and steel strands shall be\* Smooth, uniform and free from all imperfections.

After drawing and after stranding aluminium and steel strands shall be free from\* Spills and splits, die marks, scratches, abrasions, etc.,

Finished conductor shall be\* Smooth, compact, uniform

The finished conductors shall be free from\* All imperfections including kinks (protrusion of wires), wire cross over, over riding,

The finished conductors free from looseness\* Yes. (free from wire being dislocated by finger/ hand pressure and/ or unusual bangle noise on tapping)

The finished conductors free from material inclusion\* Yes. Free from White rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.

The zinc coating shall be\* smooth, continuous, of uniform thickness and and free from imperfections

The steel strands shall be pre formed and post formed in order\* To prevent spreading of strands in the event of cutting of complete core

Care shall be taken to avoid, damages to galvanisation\* During pre-forming and post forming operation

JOINTS IN WIRES

Aluminium wires during stranding\* No aluminium wire welds made for the purpose of achieving the required conductor length.

Aluminium wires: Individual wires in the outer most layer of the finished conductor.\* Without any joints (No Joints)

Aluminium wires: Individual wires in the inner layers of the finished conductor\* Joints permitted (But not more than 4 per conductor length and shall not be closer than 15 meters from joint in the same wire or in any other alur

Aluminium wires: Joints shall be made by\* Cold pressure butt welding

Aluminium wires: Cold pressure butt welding withstand a stress of\* Not less than the breaking strength of individual strand as per relevat IS/ IEC specifications

Steel Wires: In the finished wire entering into the manufacture of the strand\* No joints

Steel Wire: In any length of the completed stranded steel core of the conductor\* No strand joints or strand splices

Materials

Aluminium strands shall be\* Hard drawn from Electrolytic aluminium rods having purity and copper content as specified in the TP.

Steel: The steel wire strands

PACKING

Finished Conductor shall be supplied with\* Wooden drums

Sealing of finshed conductor\* Both end of the conductort sealed.

Drums are returnable\* Non returnable

Protection for conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field\*

Outer Covering material on the conductor after packing on drums\*

Supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.\*

CERTIFICATIONS

Availability of Type test report to prove conformity to the specification\*

Seller agreed to submit guaranteed technical particulars (GTP) to the buyer / consignee on demand\*

Agree to furnish all the test reports and certificates to the buyer/consignee\*