TECHNICAL QUALIFICATION REQUIREMENT

Name of Project: **400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)**

Name of Customer: TANGEDCO

Name of Item: 390kV Surge arrester

TECHNICAL QUALIFICATION REQUIREMENT
400 kV Class Surge Arrestors being offered should be from manufacturer who have manufactured and supplied at least Five (5) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 400 kV or above class which should have been in successful operation for minimum two (2) years as on date of Tender enquiry.

SUPPORTING DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH TECHNICAL BID		
Sr	**Required Criteria**	**Supporting Documents**
1	Manufacturing	Approved Drawings / GTP / Approved Quality Plan / Factory Inspection Test Report etc. establishing bidder as manufacturer of offered item in line with TQR
2	Supply	PO / Dispatch clearance / LR / Material Receipt certificate at site / installation or commissioning certificate etc. establishing bidder as proven supplier of offered item in line with TQR
3	Successful operation	Successful operation means certificate issued by employer/end-customer or main contractor (along with chain of document from employer/end-customer) stating successful operation without any adverse remark.

20/06/2022
PREPARED BY

20/06/2022
REVIEWED BY

20/06/2022
APPROVED BY

902206/2022/TBG-TB_HVDC

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-400-316-106	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN	-Sd-	-Sd-	-Sd-
TITLE	390 kV Surge Arrester			NAME	SS	SKS	AG
				DATE	10/09/18	10/09/18	10/09/18
				GROUP	TBEM	W.O. No	87005
CUSTOMER	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)						
PROJECT	400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)						
STATION	Udangudi						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS
01	20.06.22	SS	SKS	SKS	Revised as marked rev 01

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SECTION - 1

Scope, Quantities and Specific Technical Requirements

1.1 Scope

This technical specification covers the requirements of design, manufacture, testing at works, packing, loading at works and transport to *Udangudi site* of metal oxide gapless type arresters complete with all accessories such as insulating base, surge monitor, HV power connector, corona grading ring, insulated interconnecting cable between arrester and surge monitor, all fixing hardware for arrester units, fixing the surge monitor to structure, connecting the earthing, bypass shunts etc.

The equipment is required for the following project:

Name of customer :TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)
Name of the project : 400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)

Refer section-3 of this document for project details and general specification.

1.2 Quantities

Sl. No.	*Description*	*Quantity*
1	SUPPLY- SURGE ARRESTOR : 20KA NOMINAL DISCHARGE, 390KV, COMPLETE WITH ALL ACCESSORIES AS SPECIFIED IN THIS SPECIFICATION	33 No.

1

Quantity Variation= ±25%

1.3 Specific Technical Requirements

Technical Parameters

S. No.	*Technical parameter*	*Unit*	*390 kV Surge arrester*
1	Type	-	Metal Oxide, Gapless
2	Location	-	At the terminals of Transformer/Line
3	Applicable standards	-	IEC 60099-4
4	Installation	-	Outdoor
5	Mounting	-	Structure
6	Design Ambient Temperature	deg. C	50
7	System Neutral Earthing		Effectively earthed
8	Nominal System Voltage	kVrms	400

9	Highest System Voltage	kVrms	440
10	Rated Arrester Voltage	kV	390
11	Rated Frequency	Hz	50
12	Maximum Continuous Operating Voltage at 50 deg. C	kVrms	303
13 .1	Minimum Switching surge residual voltage (1kA)	kVp	730
13.2	Maximum Switching surge residual voltage (1kA)	kVp	780
14	Application		Surge protection of Transformer/Line/Bus Bar
15	Long duration discharge class (IEC)		4/5
16	Rated Nominal Discharge Current (8/20 µsec.)	kAp	20
17	Discharge current at which insulation co-ordination shall be done		20 kA of 8/20 µsec. wave
18	Pressure Relief Class		A
19	Minimum Energy Discharge capability	kJ/kV	8
20	Minimum Creepage requirement	mm/kV	31
21	Rated insulation levels for arrester housing		
21.1	Lightning impulse level	kVp	1425
21.2	Switching surge impulse level	kVp	1050
22	One minute power frequency withstand voltage (dry & wet)	kVrms	630
23	Maximum radio interference level at 1.05 COV		As per IEC 60099-4
24	Minimum prospective symmetrical fault current	kArms	63
25	Partial discharge at 1.05 COV	pC	≤ 10
26	Maximum residual voltage at 20 kA nominal discharge current	kVp	850
27	Max. steep current impulse residual voltage at 20 kA	kVp	925
28	Current for pressure relief test	kArms	63
29	High current short duration test value (4/10 microseconds)	kAp	163
30	Low current long duration test value (2000 microseconds)		As per IEC

The equipment must conform to the latest revision of all relevant IEC standards.

1.4 Type Tests

The bidder shall offer type tested equipment for the project and the Employer shall accept the equipment type test reports under the following conditions:

(i) Type test in accordance with the IEC 60099-4

(ii) Type tests performed not older than five (5) years from 02/07/2015

(iii) The type tested equipment shall be of the same design, insulation class and rating as per the equipment offered under this contract

In the event that equipment furnished includes important modifications of, or significant departure from, the designs of equipment on which type test report has been furnished or if there is evidence that the equipment does not comply with the requirements of the Specifications, the bidder shall conduct the type tests without any cost implication to the Employer.

SECTION – 2
EQUIPMENT SPECIFICATION

2.1 General

This section covers the general technical requirements of metal oxide arresters. In case of any discrepancies between the requirements mentioned in this section and those specified in section-3 of this specification, this section shall prevail and shall be treated as binding requirement.

The arresters are installed to protect vital equipment against the detrimental impact from over voltages produced by lightning, switching, internal or external station faults and other system disturbances.

2.2 Standards

The equipment to be furnished under this specification shall be in accordance with the applicable section of the **latest version of the relevant IS/IEC standards including amendments**, except where modified and / or supplemented by this specification.

IS 3070-3	Lightning arresters for alternating current systems – Metal oxide lightning arresters without gaps
IEC 60099-4	Metal oxide surge arresters without gaps
IEC – 60270	Partial Discharge Measurements

2.3 Technical Data

2.3.1 Electrical Data

Electrical data and testing parameters shall be in line with section 1 of this document. The supplier / bidder shall submit GTP, drawings and valid type tests reports at tender and contract stage.

2.4 Design

2.4.1.1 Arrester Design

The features and constructional details of arresters shall be in accordance with requirement stipulated hereunder.

a. Arresters shall be of hermetically sealed units, self-supporting construction and suitable for mounting on tubular support structures.
b. The lightning arresters shall be of Polymer housing, heavy duty station class and gapless type without any series or shunt gaps. 1
c. The lightning arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines. Lightning arrester shall be capable of discharging energy equivalent to specified class on two successive operations, as required by relevant standards. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured

reference voltage.

d. The non-linear blocks shall be of sintered metal oxide material. The lightning arresters shall be fitted with pressure relief devices suitable for preventing shattering of insulator housing and providing path for flow of rated fault currents in the event of arrester failure.
e. Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.
f. The arresters shall be designed to withstand a certain degree of contamination. Site pollution shall be considered as class III- Heavy as per IEC 60815.
g. Arresters shall be complete with insulating base having provision for bolting to flat surface of structure. On insulating base, ground terminal bracket shall be provided. Line terminal and ground terminal shall be of stainless steel.
h. Each single pole unit shall be provided with Surge counter and leakage current meters mounted in sheet steel enclosure of IP 55 degree of protection. The reading of milli-ammeter and counters shall be visible through an inspection glass panel. XLPE insulated copper conductor of adequate size and total 150m length (in single cut length) shall be used for connecting Surge counter terminal and lightning arrester earth terminal.
i. Bypass copper shunts shall also be provided for bypassing the discharging counter for removal / maintenance of counter.
j. The supporting structure (in BHEL scope) for lightning arrester shall be provided with a mounting pad, for fixing Surge counters and leakage current meters.
k. Grading / corona rings and intermediate ring of hot dip galvanized steel shall be provided on each arrester unit to meet the corona / RIV specification.
l. The end fittings shall be made of non-magnetic and corrosion proof material. Internal components shall be designed to minimize internal corona and also to ensure minimal capacitive coupling with any conducting layer of pollutant on the outside of the insulator housing. Organic materials are not permitted as this may influence the reliability of the arrester.

2.4.1.2 Duty Requirements

420 kV class AC arrester shall be capable of discharging energy equivalent to at least class 4/5 of IEC on two successive operations followed immediately by 50 Hz energization with a sequential voltage profile at least as specified below:

- 705 kVp for 3 peaks
- 580 kVp for 0.1 sec
- 565 kVp for 1sec
- 550 kVp for 10 sec

The arresters shall be fully stable thermally to give a life expectancy of 40 years under site conditions and shall take care of the effect of direct solar radiation.

2.4.2 Insulators

The insulator housing shall be Polymer type. The arresters shall not fail due to arrester housing contamination. The outer insulator housing shall be so co-ordinated that external flashover will

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not occur due to application of any impulse or switching surge voltage upto the maximum design value for the arrester.

2.4.3 Seismic Requirements

The arrester shall conform to the seismic requirements as specified in section-3 of this document.

2.5 Accessories

2.5.1 Surge Counters and Leakage Current Meters

Self-contained Surge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole/ phase unit. Suitable leakage current meters for the arresters with no key interlocking system during operation should also be supplied within the same enclosure. The reading of the ammeter and counters shall be visible through an inspection glass panel. The terminals shall be robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends.

Surge counters shall be mounted on support structure of the arrester and surge counters and leakage current meter shall be located in such a way that the readings can be taken during energised condition of the equipment. For this, an interconnecting XLPE insulated copper conductor of suitable size, 4 m long shall be supplied with each surge counter / leakage current meter. The conductor shall be lugged on both sides with tin plated copper lugs to facilitate bolted connections. The gaskets of the surge monitors shall be of Neoprene, Butyl or equivalent material. Sealing arrangement of the surge arrester stacks shall be done incorporating grooved flanges with the O-rings/elliptical cross section gaskets of Neoprene or Butyl rubber. Enclosure for surge counter and leakage current monitor shall be tested for IP 55 degree of protection

2.5.2 Terminals

The HV power connector shall be suitable for twin moose/bersimis conductor/4 inch (Sch 80) Aluminium tube. The earth terminal shall be designed for the connection of a cable as specified in 2.5.1 above. The maximum terminal force shall be stated in the arrester outline drawing.

2.5.3 Base

Each installed arrester shall be equipped with an insulating base having provision for bolting to flat surface of structure.

2.5.4 Fixing Hardware

Hot dip galvanized (M10 and above) or electro-galvanized (below M10) hardware shall be provided for the following, as applicable.

- Bolting of individual arrester units and unit to insulating base.
- Bolting of insulating base to steel structure / concrete pedestal.
- Bolting the surge monitor and leakage current meter to structure / concrete pedestal.
- Bolting the HV and LV terminals to the arrester.
- Bolting the interconnecting copper conductor from arrester earth terminal to surge monitor.
- Bolting of corona ring to arrester unit.

Where required, plain washers with spring washers, plain and lock nuts shall be provided.
10% extra hardware shall be supplied marked as spare.

2.5.5 Nameplates

The material of nameplate shall be stainless steel. The information on the Nameplates shall be in accordance with IEC 60099-4, clause 4.1 and as mutually agreed with the owner.

2.6 Tests

The following tests shall be carried out on the arresters.

2.6.1 Type Tests

Certified test reports of previously performed type test on similar units may be submitted for approval, unless specified otherwise in section-1 of this document. Old test reports shall be submitted together with a technical report from the supplier, giving details regarding similarities and differences in the design to support the approval. Such type test reports, if approved, are accepted in lieu of performing new type tests. These type test reports should not be older than 5 years from the date of 02/07/2015. The type tests shall be carried out free of charge and without delivery implications, in case the test report is found unsatisfactory.

2.6.2 Routine Tests

2.6.2.1 Reference voltage test

A reference voltage test shall be performed in accordance with clause 9.1a) of IEC 60099-4. The test shall be performed on each arrester unit at the manufacturer's specified reference current.

2.6.2.2 Arrester residual voltage

The test shall be carried out at the nominal lightning discharge current (specified in section-1 of this document) and in accordance with clause 9.1b) of IEC 60099-4.

2.6.2.3 Partial discharge test

This test shall be carried out in accordance with clause 9.1c) & d) of IEC 60099-4.
Additional corona shielding of external parts is permitted for the internal partial discharge tests, provided that the shielding does not affect internal voltage grading.

2.6.2.4. Current distribution test

2.6.2.5 Leak test

This test shall be carried out in accordance with clause 9.1e) of IEC 60099-4.

2.6.2.6 Verticality check on completely assembled surge arresters

An arrester unit is defined as an assembled unit with end fittings. Verticality check on completely assembled surge arresters.

2.6.3 Routine Test on Surge Counters

The surge counters shall be connected in series with the test specimens during residual voltage

and current impulse withstand tests to verify efficiency of the same. Additional routine/functional tests with one 100 A (switching surge) and 10 kA current impulse, (8/20 microsec) shall be performed on the surge counter.

2.6.4 Acceptance Tests

The acceptance tests shall be carried out by the supplier on arresters of each type and rating as per IEC 60099-4, clause 9.2.

1.	Reference Voltage Measurement	9.2.1a)
2.	Lightning Impulse Residual Voltage Test	9.2.1b)
3.	Partial Discharge Test	9.2.1c)
4.	Special Thermal Stability Test	9.2.2
5.	Watt loss test	--
6.	Aging & energy capability test on blocks	--

SECTION 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 SITE INFORMATION

SL.NO.	DESCRIPTION	
3.1	**PROJECT INFORMATION**	
	a) Customer	Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
	b) Project	400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
	c) Project location	
	i) Country	India
	ii) State	Tamil Nadu
	iii) Administrative district	Thoothukudi
	iv)Next Big cities to site	Thoothukudi (approx.. 45 kms from site)
	v) Road access	East Coast Road- State high way (176)
	vi) Nearest Railway Station	Thiruchendur (approx.. 12 kms from site)
	vii) Nearest Airport	Vagaikulam (approx.. 60 kms from site)
	viii) Nearest Harbour	Tuticorin (approx.. 45 kms from site)
3.2	**SITE CONDITIONS**	
3.2.1	Ambient Air Temp.	

	a) Maximum dry bulb temp. (max.) °C	41^0C
	b) Minimum dry bulb temp. (min.) °C	17^0C
3.2.2	**Relative humidity**	
	Mean Maximum humidity (Summer)	84 %
	Mean Minimum humidity (Summer)	62 %
	Maximum humidity (Monsoon)	97%
	Minimum humidity (Monsoon)	45%
3.2.3	**Rain fall**	
	Annual rainfall (Maximum)	718.2 mm
	Annual rainfall (Minimum)	384.1 mm
	Twenty four (24) Hour max	138.2 mm
3.2.4	**High Flood Level**	
	High Flood Level for site	RL 2.450 m
3.2.5	**Wind**	
	Mean Wind Speed (max)	39 m/sec (As per IS: 875)
	Wind direction	North, North east, North west, East
3.3	**Seismic intensity**	
	Seismic Intensity	As per IS:1893 Latest
	Zone	II

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the Manufacturer may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

3.3 STANDARDS

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) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification.

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

When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner’s approval.

The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All equipment shall also perform satisfactorily under various other electrical, electro mechanical and meteorological conditions of the site of installation All equipment shall be able to withstand all external and internal mechanical, thermal and electro mechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

The Supplier shall necessarily submit all the drawings/ documents unless anything is waived. The Supplier shall submit drawings/ design documents/ data/ test reports/manuals as may be required for the approval of the purchaser. All drawings submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Manufacturer shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the Owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. Owner may not indicate a thorough review of all dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and /or approval by the Owner shall not be considered by the Manufacturer, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Manufacturer's risk. The Manufacturer may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Manufacturer’s drawing or work by the Purchaser shall not relieve the manufacturer of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the Manufacturer after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

The title block of drawings shall contain the following information incorporated in all contract drawings

Title block for project:

1. Customer : Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
2. Consultant : DESEIN PRIVATE LIMITED, DESEIN HOUSE, NEW DELHI
3. Project : 400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
4. Contract No./LOA No. : Lr.No.CE/Proj.II/SE/C/UTPP/EE/E/LOI/D.179/2017, dt.07.12.2017
5. Main Contractor : Bharat Heavy Electricals Limited
6. BHEL Order No. & Date :

3.5.2 Documentation

Document Distribution Schedule - After Placement of Order:

S. No.	Stage	No. of copies	
i)	Submission of Data sheets Datasheet, drawings, documents, write-ups, calculation, test reports, Preliminary	13	As per agreed schedule
ii)	Resubmission of above, if required	13	As per agreed schedule
iii)	Final approved documents	13	As per agreed schedule
iv)	Instruction manuals for erection and O&M	6	As per agreed schedule
v)	As built drawings including O &M manual -Hard copy -Soft copy in CD/Pendrive	 13 6	As per agreed schedule

NOTES:

a) The manufacturer may note that all re-submissions must incorporate all comments given in the prior submission by the Purchaser. Adequate justification for not incorporating the same must be submitted, failing which the submitted documents may be returned.

3.5.3 Format of Documentation

a) All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.
b) Two set of CD/ pendrive containing all the drawings in Auto CAD shall also be supplied in addition to hard copies. Soft copy of all documents shall be supplied in a CD/pendrive in PDF format.
c) Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

3.5.4 Instruction manuals and operating manuals

The Supplier shall provide Instruction & Maintenance Manuals for each part of the Plant and Equipment included in the Works and Operating Manuals for each Station.

The Instruction Manuals and Operating Manuals shall be arranged in an organized library adequately cross referenced to facilitate issuing clauses of the manuals as required by the work i.e. erection instructions shall be required before operating & maintenance instructions.

All Manuals provided by the Supplier shall be fully detailed and specifically prepared for the Works and equipment provided. General manuals not specifically required for the work shall not be acceptable.

The instruction manuals shall at least contain:

a) A general description of all components
b) Storage instructions
c) Erection instructions
d) Pre-commissioning Instruction:
e) Material and part list.
f) Design clearances and settings
g) Complete sets of drawings as finally issued
h) Operating Instructions:
i) Routine and Preventive Maintenance instructions with material requirement for each site
j) Preventive Maintenance Schedule.
k) Replacement instruction for all equipment

The operation manuals shall at least contain:
a) Operator oriented functional descriptions of the equipment.
b) Operator oriented description of the protection and control systems
c) Description of the equipment auxiliary systems
d) Fault finding and diagnostic tools
e) User software interface tools for modification/augmentation etc.

Notes:

The supplier may please note that all resubmissions must incorporate all comments given in the earlier submission by the Owner/Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Supplier to the Owner/Purchaser.

The Supplier shall furnish to the Owner/Purchaser, catalogues of spare parts also.

3.6 QUALITY ASSURANCE PROGRAMME

This section contains general requirements for inspection of material, parts, equipment and workmanship during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of product operation and performance.
The Owner and/or authorized Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the items available for the purpose of inspection of the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.
The approval of the Owner shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Manufacturer's Works or at his Sub-manufacturer's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Manufacturer shall adopt a suitable quality assurance programme to control such activities at all points, as necessary.
Before manufacture commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner's Representative. The detailed manufacturer’s quality assurance plan shall be subject to approval after award of contract.

The Owner will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent prior to the intended test. If the Owner intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, an alternative date has to be informed by the Owner.
A quality assurance programme of the manufacturer shall generally cover the following:

(a) Manufacturer's organisation structure for the management and implementation of the proposed quality assurance programme:
(b) Documentation control system;
(c) Qualification data of bidder's key personnel;
(d) The procedure for purchases of materials, parts components and selection of sub-Manufacturer's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
(f) Control of non-conforming items and system for corrective actions;
(g) Inspection and test procedure both for manufacture and field activities;
(h) Control of calibration and testing of measuring instruments and field activities;
(i) System for indication and appraisal of inspection status;
(j) System for quality audits;
(k) System for authorising release of manufactured product to the Purchaser
(1) System for maintenance of records;
(m) System for handling storage and delivery; and
(n) A quality plan detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered. The Purchaser or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and Procedure of the Manufacturer/his vendors quality management and control activities.

3.7 Quality Assurance Documents

The Manufacturer shall be required to submit all Quality Assurance Documents as stipulated in the quality plan at the time of purchaser’s inspection of equipment/ material.

3.8 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The

Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the technical specification or any/all additional type tests not carried out, Such test shall be conducted fresh without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Manufacturer, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Manufacturer shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser/ inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

When the factory tests have been completed at the Manufacturer's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser/inspector, the certificate shall be issued within fifteen (15) days of receipt of the Manufacturer’s Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Manufacturer from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should it, on further tests/ after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of MICC by the Purchaser.

In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give

facilities to the Purchaser Inspector or to his authorised representative to accomplish testing.

The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Contract.

The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Purchaser.

3.9 MATERIALS AND WORKMANSHIP

Equipment materials and components shall be new, of high grade and good quality and be to the latest engineering practice. The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

All the information concerning materials or components to be used in manufacturing, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the supplier shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall be borne by the supplier.

3.10 COLOUR SCHEME

The Supplier shall propose a colour scheme for the equipment for the approval of the Employer. The decision of the Employer shall be final. However, the finishing colour shall be RAL 7035 for all Control panels/ MCC/ Switchgear panels. The scheme shall include:

- Finishing colour of Indoor equipment
- Finishing colour of Outdoor equipment
- Finishing colour of various auxiliary system equipment including piping
- Finishing colour of various building items.
- Finishing colour of all cubicles.

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. The galvanised structures in the switchyard shall not be painted. However galvanised structures in other areas may require painting for aesthetic reasons.

3.11 PACKING AND STORAGE

Packing specification shall be submitted for BHEL/customer approval after award of contract.
All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. On request of the purchaser, the manufacturer shall also submit packing details/associated drawing for any equipment/ material at a later ate, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc shall be to the account of the manufacturer. Purchaser takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device.

Supplier shall ensure that equipment shall be properly packed, blocked, padded, coated and protected so that it is not damaged due to possible mishandling. Storage requirements shall be clearly defined by the supplier. Packing shall be such that if required, long time storage (at least 2 years) at site should not deteriorate the performance of the equipment.

3.12 NAME PLATE

Name plates which are to be firmly fixed on all the equipment, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.
The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipments (e.g., panels, cabinets, switchgear, etc.) shall also be labelled by appropriate name plate.
The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags.

The Equipment identification shall be finalized by vendor in consultation with BHEL/TANGEDCO and should be included in name plates.

3.13 CLAMPS & CONNECTORS

i) All power clamps and connectors shall conform to lS: 5561, and/or IEC standard and shall be made of materials listed below:

a)	For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all tests as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2 mm thick Bimetallic liner and shall be tested as per IS: 617.
c)	For connecting G.I. Shield wire	Galvanised mild steel
d).1	Bolts, nuts & Plain washers.	Electro galvanized for sizes below M12, for others hot dip galvanised
d).2	Spring washers for items 'a' to 'c'	Electro-galvanised mild steel suitable for at least service condition-3 as per lS: 1573

ii) Equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type. The requirements regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. In case the connector is not available then equivalent connector may be used. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of Work.

iii) Where copper to aluminium connections are required, bi-metallic clamps shall be used, which have been properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current t shall be furnished to the Employer.

iv) Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified are also included in the scope of Work.

v) No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body for Bi-metallic clamps. When copper alloy is not cast integral with aluminium body, a bimetallic washer or strip shall be used to meet the functional requirement.

vi) All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

vii) Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of IPS Aluminium tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

viii) Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

ix) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

x) TESTS

The following is the list of type tests.

a) Temperature rise test (maximum temperature rise allowed is 35deg C over 50 deg C ambient)
b) Short time current test
c) Dry corona and RIV test as per annexure-A
d) Resistance test and tensile test

3.14 GALVANIZING

Galvanizing works shall conform in all respect to B.S. 729, B.S. 3083 and B.S.C.P. 2008 and to DIN 50976 whatever requires the higher quality and shall be performed by the hot dip process, unless otherwise specified. It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with B.S 4479.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably be blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with B.S. 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants in

accordance with DIN 55928, part 4 and DIN 50976. The weight of zinc coating per unit area has to be noted in the manufacturing documents in accordance with DIN 50976.
The minimum average coating weight shall be as specified in Table 1 of B.S. 729 or Table 2, DIN 50976, whatever requires higher quality.
Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 610 g/m2 (DFT = 85µ) .
On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.
Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor (defined in B.S. 3294, part 1 and B.S. 4604,
part 1) is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.
Bolts, nuts and washers, including general grade high-tensile friction grip bolts (referred to in B.S. 3139, and B.S.4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to B.S. 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is possible in accordance with DIN 50976.
Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with DIN 55928, part A and DIN 50976 by:

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- Application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with DIN1707, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface. Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with DIN 2444.
After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint.

Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.

3.15 DEGREE OF PROTECTION

The enclosures of the control cabinets, Junction boxes and Marshalling boxes, panels etc. to be installed as detailed here under:

The minimum requirements for panels are as follows:

- Installed out door: IP- 55
- Installed indoors in air-conditioned area: IP-32
- Installed in covered area: IP-52
- Installed indoors in non air-conditioned area where possibility of entry of water is limited: IP-41.
- For LT Switchgear (AC & DC distribution Boards): IP-52.

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-947 (Part-I) / IS 12063 / IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval