



**BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
ENGINEERING MANAGEMENT, NOIDA, SECTOR-142**

COPYRIGHT AND CONFIDENTIAL The information contained in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED This must not be used directly or indirectly, in any manner detrimental to the interest of the company	BHEL Document No.		Rev		Prepared by	Checked by	Approved by
	TB-407-316-003		00	Name	NK	NK	SKS
	Type of Document			Sign			
	TECHNICAL SPECIFICATION						
	Title			Date			
	624 & 336kV SURGE ARRESTER				08.04.19	08.04.19	08.04.19
				Group	TBEM		
	CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD.						
	PROJECT: Extension of 765/400kV S/S, Bara TPS (U.P.)						
	LOI NO: 121/ESD-765kV/13/Bara/Vol-1, Dated: 08.03.2019.						
CONTENTS							
SECTION		TITLE				PAGE	
1		Scope, Specific Technical Requirements & Quantities				04	
2		Equipment Specification				04	
3		General Technical Requirement				21	
4		Annexure – A (No deviation certificate)				01	
5		Check List				03	
Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS		
Distribution				To			
				Copies			

SECTION 1 SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 624 & 336 kV Surge Arrester complete with accessories as listed under this specification. These arresters shall be used for protection of 765/400/33kV ICT.

This section covers the specific technical requirements of Surge Arrester. This constitutes minimum technical parameters for the above item as specified by the customer (UPTCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements & Quantities

Section-2: Equipment Specification

Section-3: General Technical Requirements

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Uttar Pradesh Transmission Corporation Ltd.

Name of the project: Extension of 765/400kV S/S, Bara TPS (U.P.)

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Sl. No.	Description	Unit	624 kV SA	336 kV SA
1	Type		Outdoor. Heavy duty, station class, metal oxide gapless	Outdoor. Heavy duty, station class, metal oxide gapless
2	Rated network maximum operating voltage	kVrms	800	420
3	Rated Arrester voltage (Ur)	kVrms	624	336
4	Rated continuous operating voltage as per IEC (UC)	kVrms	490	267
5	Rated discharge current (8/20 μ s)	kApeak	20	20
6	Switching impulse current (peak)	kA	2	2
7	Line discharge class (IEC 60099-4)		5	4
8	Rated frequency	Hz	50	50
9	Max. residual voltages for: - Lightning impulse current, 8/20 μ s, 20 kA	kVp	1474	897
10	Max. residual voltages for: - Switching impulse current, 30/60 μ s, 2 kA	kVp	1215	728
11	Energy dissipation capacity	kJ/kV	15.4	10
12	High current impulse withstand (4/10 μ s)	kA	100	100

13	Temporary overvoltage withstand (for 10 s)	kV	660	396
14	Housing material		Porcelain	Porcelain
15	Lightning impulse withstand voltage	kVp	≥ 2100	≥ 1425
16	Switching impulse withstand voltage	kVp	≥ 1550	≥ 1050
17	Power frequency withstand voltage (1min. wet)	kVrms	≥ 975	≥ 630
18	Creepage distance	mm	25mm/kV	25mm/kV
19	Cantilever strength	KGM	≥ 500	≥ 500
20	Pressure relief capacity - current amplitude (rms) - X/R, asymmetry factor - current duration	kASYM - s	≥ 40 30 0,2	≥ 40 30 0,2
21	External radio interference voltage (RIV) RIV max. voltage level (IEC 60694) at 0,5 MHz	μV	2500	500

1.3 Quantity

A) Main Item

Sl. No.	Item	Quantity
1	624kV, 20kA, Metal-oxide, gapless type, Surge Arrester complete with insulator base and discharge counter with leakage current monitor & fixing hardware to support structure.	03 Nos.
2	336kV, 20kA, Metal-oxide, gapless type, Surge Arrester complete with insulator base and discharge counter with leakage current monitor & fixing hardware to support structure.	03 Nos.
3	Terminal connector for 624kV Surge Arrester suitable for Quad Bull AAC conductor	03 Nos.
4	Terminal connector for 336kV Surge Arrester suitable for Twin Bersimis ACSR conductor	03 Nos.
5	Insulated connecting cable between surge arrester and surge monitor (single length)	45m

Note: 1. Total quantity may vary up to $\pm 20\%$.
2. Terminal connector shall be suitable for horizontal take off.
3. Sub-conductor spacing for conductor is 450 mm.
4. Insulated connecting cable between Surge Arresters and Surge monitor shall be supplied in single length for all required surge arresters. Please note that connecting lead, lugs and accessories shall be provided with each Lightning Arrester.

B) Mandatory Spare:

Sl. No.	Item	Quantity
1	624kV, 20kA, Metal-oxide, gapless type, Surge Arrester complete with insulator base and discharge counter with leakage current monitor	1 No.

1.4 Pre-qualification Requirement

A. OPERATIONAL EXPERIENCE

Offered equipment should have given three years proven trouble free operational service in tropical climate from date of bid opening (02.03.2019).. However, in case of equipment manufactured in India under valid foreign collaboration, operating experience in tropical climate of offered collaborator's equipment, shall also be acceptable provided copy of valid collaboration agreement for the offered equipment is submitted with the proposal. Further in case of offer of imported equipment, three year operating experience shall be considered in respect of those areas only which are similar to the tropical conditions prevailing in India.

B. MANUFACTURING EXPERIENCE

The indigenous manufacturers or their foreign collaborator must have manufactured at least 20% of the specified quantities of each item of identical or similar equipment as on date of bid opening (02.03.2019).

C. TESTING FACILITIES:

The manufacturer must have all necessary facilities at their works for carrying out such routine and acceptance tests as prescribed in the relevant ISS/IEC and any other routine and acceptance test as specified in the specification. Documentary evidence of existence of such facilities will be submitted along with the proposal.

1.5 TYPE TESTS

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years from the date of bid opening of Bara (02.03.2019). The reports should have been conducted on identical or similar equipment/components to those offered. The test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment.

In case type test reports are more than 5 years old (from 02.03.2019) or the reports of type tests are found to be technically unacceptable by BHEL/UPPCL, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.6 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the bidder factory, provided by the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on each item in accordance with the applicable IEC/IS and the material shall be offered for final inspection by BHEL and UPTCL in accordance with agreed quality plan with 3 weeks advance information. The charges for these shall be deemed to be included in the equipment price.

1.7 QUALITY PLAN

The bidder 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 requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Bidder shall submit detailed Quality Plan for BHEL / customer's approval at contract stage.

1.8 SPECIAL TOOLS AND TACKLES:

Bidder shall supply all special tools and tackle free of cost which are specifically required for the Surge arresters and are proprietary in nature. List of such special tools and tackle should be clearly listed along with the technical offer. Any special tool which is not listed in the list but required during the erection/testing/commissioning of surge arresters shall also be supplied free of cost by the supplier.

1.9 TITLE BLOCK

The drawings / documents submitted shall be project and product specific and shall incorporate following details:

- a) Project Name : Extension of 765/400kV S/S, Bara TPS (U.P.)
- b) Customer Name : Uttar Pradesh Transmission Corporation Ltd.
- c) Contractor : BHEL
- d) Customer LOI No. : 121/ESD-765kV/13/Bara/Vol-1, Dated: 08.03.2019.

SECTION - 2

EQUIPMENT SPECIFICATION

2.1 General

The surge Arrester shall be of a manufacturer's proven design and operational experience and shall meet or exceed the requirements of this specification in all respects.

2.2 Design and Manufacturing

The surge Arrester shall comply with the requirements indicated in the Technical Data Schedules. The HV gapless metal oxide surge Arresters shall come with porcelain insulator and supplied with insulating bases and discharge counter.

2.3 Accessories

2.3.1 Pressure Relief Device

A pressure relief device shall be provided with each surge Arrester to ensure that the failure of same will not cause explosive shattering of the insulator housing. The pressure relief device shall be capable of withstanding the symmetrical fault current of the system as specified in the Data Technical Schedules. The pressure relief device shall be designed to ensure the safety of operation personnel or other apparatus in its vicinity.

2.3.2 Corona Rings and Grading Rings

Arresters shall be equipped with grading rings and corona rings as required to meet the performance of the arresters.

2.3.3 HV Terminals and Connectors

The HV terminals shall be provided according to the bidder's detailed design for bundled conductors.

2.3.4 Grounding Terminals

The grounding terminals, suitable for connection with 75x12 mm G.S. Flat, shall be provided with connectors. This applies to surge counters and Arrester terminals.

2.3.5 Equipment Support

Pipe type supports will be used for the 336kV surge Arresters & lattice structures shall be used for 624kV surge arresters.

2.3.6 Discharge Counter

Surge arresters shall have a surge (discharge) counter along with a built-in milliammeter to monitor the leakage / internal current of the surge Arrester continuously. The display unit shall also be provided. It will be advantageous if the display is large enough so that surge current is visible from a reasonable distance.

The surge counter shall record the number of lightning and switching discharges of the surge Arrester automatically on a five-digit cyclometer dial/display unit. The surge counter shall be non-reset table and capable of registering up to 5 discharges per second.

The meter shall be capable of displaying currents of up to 50mA peak.

The leakage and internal current indicator shall monitor and measure the sum of leakage current across the external porcelain insulator plus the internal current flowing through the surge Arrester. The scale range shall be 0-50 mA peak/ $\sqrt{2}$ (non-linear scale)

The surge counter and leakage/ internal current indicator unit shall be maintenance-free, weatherproof, sealed type.

Insulated cable connection shall be provided between surge Arrester ground terminal and surge monitor. The insulation withstand of the cable shall be 5 kV minimum. By pass shunt shall be provided to establish continuity to ground from the surge Arrester ground terminal for easy maintenance.

2.3.7 Nameplate

As specified in section-3.

2.4 SCOPE OF SUPPLY OF ASSOCIATED ITEMS AND ACCESSORIES, SPARE PARTS AND TOOLS

The supply of equipment shall include the following:

- a) HV terminals;
- b) Grounding terminals;
- c) Mounting hardware;
- d) Discharge counters with mounting hardware
- e) Connectors
- f) Insulating bases.
- g) Grading/corona ring as applicable
- h) Other standard accessories which are not specifically mentioned but are usually provided with Lightning Arrester of such type and rating for efficient and trouble-free operation.

2.5 SHOP TESTING AND INSPECTION

The surge Arresters shall be subjected to type and routine tests in accordance with the relevant IEC/IS. The bidder shall provide the list of such tests as per IEC/IS after award of the Contract for UPPCL's approval. All tests results shall be submitted to the UPTCL for review and acceptance by the UPTCL.

2.5.1 Type tests

Bidder to submit valid type test reports as per clause 1.5 of section-1. The type tests shall include the following as minimum:

- Insulation withstand tests on the Arrester housing
- Steep current impulse residual voltage test
- Lightning impulse residual voltage test
- Switching impulse residual voltage test
- Long-duration current impulse withstand test
- High-current impulse operating duty test
- Switching surge operating duty test
- Short circuit test
- Arrester disconnector/ fault indicator test
- Polluted housing test
- Internal partial discharge test
- Bending moment test
- Environmental tests
- Seal leak rate
- Radio interference voltage (RIV) test

2.5.2 Routine tests

All routine tests prescribed in the relevant IEC 60099-4 or ANSI C62.11 standard shall be performed on all surge Arresters. The routine tests shall include the following as minimum:

- Measurement of reference voltage (U_{ref})
- Residual voltage test
- Internal partial discharge test
- Current distribution test for multi-column Arrester

2.5.3 Special tests for 765kV Surge Arresters

Acceptance tests (or Conformance Tests per ANSI C62.11, as applicable) shall be performed in accordance with IEC 60099-4, namely, on the nearest lower whole number to the cube root of the number of arresters to be supplied. These tests should be applied to the 765kV surge Arresters only. The IEC 60099-4 2004 Acceptance tests are listed as the following:

Standard acceptance tests:

- Measurement of power-frequency voltage on the complete Arrester at the reference current measured at the bottom of the Arrester. The measured value shall be within a range specified by the manufacturer. For multi-unit Arresters, the value may deviate from the reference voltage of the Arrester.

- Lightning impulse residual voltage on the complete Arrester or Arrester unit (see IEC-60099-4 section 8.3), at nominal discharge current if possible or at a current value chosen according to 8.3. In this case, the virtual time to half-value on the tail is less

important and need not be complied with.

The residual voltage of a complete Arrester is taken as the sum of the residual voltages of the individual Arrester units. The residual voltage for the complete Arrester shall not be higher than a value specified by the manufacturer.

- Internal partial discharge test

The test shall be performed on the complete Arrester or Arrester units. The test sample may be shielded against external partial discharges. The power-frequency voltage shall be increased to the rated voltage of the sample, held for 2s to 10s, and then decreased to 1.05 times the continuous operating voltage of the sample. At that voltage, the partial discharge level shall be measured according to IEC 60270. The measured value for the internal partial discharge shall not exceed 10 pC. Any alteration in the number of test samples or type of test shall be negotiated between the manufacturer and the purchaser.

Special thermal stability test

This test shall be performed on three totally different test sections consisting of metal oxide resistors taken from current routine production and having the same dimensions and characteristics as those of the Arresters under test. The test consists of a part of the operating duty test relevant to the type of Arrester as indicated in table 1 herein (or Figure 5 of IEC-60099-4).

Metal-Oxide resistor temperature or resistive component of current or power dissipation shall be monitored during the power frequency voltage application to prove thermal stability. The test is passed if thermal stability occurs in all three samples (see IEC-60099-4 section 8.5.6). If one sample fails, agreement shall be reached between the manufacturer and the purchaser regarding any further tests.

Table 1– Thermal stability test on 10 000 A Arresters line discharge Classes 2 and 3 and 20 000 A Arresters line discharge Classes 4 and 5

Preheat to 60 deg. C +/- 3K	
Long duration current impulse	see IEC-60099-4 section 8.4.2
50s to 60s	
Long duration current impulse	see IEC-60099-4 section 8.4.2
As short as possible	see IEC-60099-4 section 8.5.5.2
not longer than 100ms	
Elevated rated voltage, 10s	
Elevated continuous operating voltage, 30 min	

2.6 CODES AND STANDARDS

IEC 60099-4: Metal-oxide surge Arresters without gaps for a.c. systems

IEC 60099-5: Surge Arresters – Selection and application recommendations

IEC 60815: Guide for the selection of insulators in respect of polluted conditions

ISO 9001: Quality systems. Model for quality assurance in Design, Development, Production, Installation and Servicing.

SECTION 3 GENERAL TECHNICAL REQUIREMENTS

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) 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, equipments and services covered under respective equipment sections and are not exclusive. However, in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

It is not the intent to specify completely in technical specifications of equipments/materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. BHEL/UPPCL will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

UPTCL procures all the equipment and materials for substations, keeping into consideration the interchangeability and future extension of substation. All equipment and materials to be supplied shall conform to the UPTCL's current Bid specifications for similar equipment and materials.

2.0 COMPLETENESS OF EQUIPMENTS

2.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

2.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to noncompliance with the requirement stipulated in the Technical Specification and/or IEC/136IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated. The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening (02.03.19). The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

3.0 STANDARDS

3.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.

3.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3 In the event of the Bidder offering equipment conforming to standards other than ISS/ IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.

3.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.

3.5 Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the Purchaser.

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 deg. C
(b)	Minimum ambient air temperature in shade	0 deg. C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	soceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conducive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	800kV, 420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by $\pm 5\%$

- (iii) Number of phases Three
(iv) Neutral Effectively Earthed
(v) **Auxiliary power supply:-**
Auxiliary electrical equipment shall be suitable for operation on the following supply system:
- | | |
|--|--|
| (a) Power device (Like drive motors) | 400V, 3Phase, 4Wire 50Hz
Effectively earthed AC system. |
| (b) Lighting fixtures, space heaters, fractional Horse Power motors and control devices. | 250V, 2wire, 50Hz,
AC supply with one point grounded. |
| (c) DC alarm, Control and Protective | 2wire ungrounded DC supplies |

Devices from sub station batteries as under

- | | |
|------------------------------|-----------|
| (i) 765kV S/S | : 220V DC |
| (ii) 400 kV S/S | : 220V DC |
| (iii) 220/132kV S/S | : 110V DC |
| (iv) Communication equipment | : 48 V DC |

The above supply voltage is subject to variation as follows:

All devices must be suitable for a continuous operation over the entire range of voltage variations :

- | | |
|---------|---|
| (i) AC | Voltage may vary by $\pm 10\%$.
Frequency by $\pm 5\%$
Combined Voltage & frequency by $\pm 10\%$. |
| (ii) DC | a) 220 V may vary between 187 & 242 V
b) 110 V may vary between 93 & 121 V
c) 48 V may vary between 41 & 53 V |

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

Sl. No.	Description of Parameters	765 kV System	400 kV System	33 kV System
1.	Nominal system voltage	765kV	400kV	33kV
2.	Maximum operating voltage of the system(rms)	800kV	420kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated short time current	40/50 kA for 1 Sec	40/50 kA for 1 Sec	25 kA for 3 sec
6.	Dry and wet one minute power frequency withstand voltage	830 kV	680 kV	70 kV
7.	Full wave impulse withstand voltage (1.2/50 microsec.)	2100 kVp	1550 kVp	170 kVp
8.	Corona extinction voltage	508kV	320 kV	--
9.	Max. Radio interference voltage for frequency between 0.5 MHz	2500 micro-volt at	1000	--

	and 2 MHz	508 kV rms	micro-volt at 266 kV rms	
10.	Minimum total creepage 25mm/kV	20000 mm	10500 mm	1300 mm
11.	Min. clearances			
	Phase to phase	7600mm (for Conductor configuration) 9400mm (for rod -Conductor configuration)	4000mm (for Conductor configuration) 4200mm (for rod - Conductor configuration)	320 mm
	Phase to earth	4900mm (for Conductor structure) 6400mm (for rod- structure)	3500 mm	320 mm
	Sectional clearances	10300 mm	6500 mm	3000 mm
12.	System neutral earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site. All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment. The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand. All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing. To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

8.3 Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.

8.4 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.

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

8.6 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 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

8.7 The clamps/ connectors 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 specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.

8.8 All current carrying parts shall be designed and manufactured to have minimum contact resistant.

8.9 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 765kV, 400kV, 220kV and 132kV class clamps shall not be less than 508,320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000, 1000 and 500 micro volts for 765kV, 420kV, 220kV and 132Kv system at the test voltage specified.

9.0 SUPPORT STRUCTURES

9.1 The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 765/400/220/132/33kV Substations.

9.2 All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.

9.3 The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of purchaser. The decision of Purchaser shall be final. The scheme shall include.

Finishing colour of Indoor equipment.

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5.

11.0 MATERIAL/ WORKMANSHIP

11.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest

grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits. Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Bidder. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

11.2 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

12.0 Void

13.0 FUNGI STATIC VARNISH

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

14.0 void

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc. to be installed shall be provided with degree of protection as detailed here under:

- b) Installed out door : IP-55
- d) Installed indoor in air conditioned area : IP-31
- f) Installed in covered area : IP -52
- h) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41
- j) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

17.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

18.0 PACKAGING AND PROTECTION

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. The

Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 SURFACE FINISH

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

All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified.

The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade No. 631 of IS: 5.

20.0 HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection. After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

23.1 All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.

23.2 Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

23.3 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.

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

23.5 All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.

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

23.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

23.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch. For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

23.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

23.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

23.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ earthing by pasting the same on the inside of the door.

23.12 a) The following routine tests along with the routine tests as per IS: 5039 shall also be conducted.

Check for wiring

Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

23.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS. The following type test reports on auxiliary switches shall be submitted:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

(b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

(c) Heat run test on contacts.

(d) IR/HV test etc.

24.0 TERMINAL BLOCKS AND WIRING

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

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

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

24.4 The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

24.5 The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.

24.6 The terminal blocks shall be of extensible design.

24.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

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

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

- a) All circuits except CT circuits Minimum of 2 nos. of 2.5 sq. mm copper flexible
- b) All CT circuits Minimum of 4 nos. of 2.5 sq.mm copper flexible

24.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

24.11 At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.

24.12 There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

24.13 The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

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

25.0 LAMPS AND SOCKETS

25.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

25.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

25.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

25.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/switchfuse units. Selection of the main and Subcircuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite silicon rubber insulator, conforming to IEC- 61462.

26.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

26.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

26.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

26.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in

any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

26.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

26.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621.

27.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

27.1 Enclosures

a b) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

27.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system.

27.3 Starting Requirements

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified, shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds

above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

27.4 Running Requirements

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests along with list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

- (a) Insulation resistance.
- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

28 DOCUMENTATION

The successful Tenderer or Bidder shall provide the following technical information:

- General outline drawings of all major equipment
- Estimated works programme (Bar Chart)
- Completed technical data schedules
- Type Test Reports
- Quality assurance and quality control programme and organization
- Complete set of catalogues

The following additional information shall be provided before proceeding with the manufacturing, or during the manufacturing period:

- Schedule of engineering documents including drawings
- Assembly drawings, list of materials including spare parts and tools, cabling diagrams, etc.
- Instruction and service manuals
- Paint samples, if requested by UPTCL
- Test reports and certificates
- Shop inspection and testing program
- Packing drawings, if requested by UPTCL
- Marking models, if requested by UPTCL
- List of test required for commissioning
- Detailed procedure for installation
- Detailed procedure for commissioning
- Works programme and schedule (bar-chart)
- Progress report of manufacturing

The Bidder is responsible for any discrepancies, errors or omissions in the submittals whether these have been reviewed by the UPTCL or not, provided that such discrepancies, errors and omissions are not due to inaccurate information or particulars furnished in writing by the UPTCL to the Bidder. All reports or drawings must be provided in the SI unit system.

28.1 Drawings

The successful Tenderer or Bidder shall prepare and submit for review of the UPTCL, the drawings indicated in this document. The drawings must be A1 format (841 x 594 mm), A3 (420 x 297 mm) or A4 (297 x 210 mm) format and include in the lower right-hand corner, a title block as indicated in section-1.

The successful Tenderer or Bidder shall submit, one (1) Autocad computer file on a CD-ROM Disk and by E-mail, plus four (4) paper copies of each of the drawings to the UPTCL. The copies marked by the UPTCL will be returned to the Bidder, at the latest, 30 days after presentation of these drawings. The corrected drawings will be submitted once more, following the same procedure, if necessary.

An updated Autocad computer file, plus six (6) paper copies of the final version of the drawings, must be submitted by the Bidder, at the latest one (1) month before delivery of the purchased equipment.

28.1.1 Outline and Foundation Drawings

Outline drawings must be provided to scale including dimensions, weight, reaction for design of foundations, centre of gravity for transportation and installation, in plan view, elevation, section and foundation plan including blockouts embedded parts.

Design briefs and detailed drawings must be presented for all metallic structures and supports of the substation equipment. Nameplates, to scale, must indicate test results from the factory, serial number, weight mass, etc. When available, catalogues references and codes must be indicated on the drawings.

28.1.2 Assembly Drawings

A bill of material must be provided with all assembly drawings.

Every device or apparatus must be identified using a numerical or alphanumerical system corresponding to the one used for the respective diagram. The identification will be in accordance with the ANSI C37.2 standards. The terminal blocks must be identified on the drawing as they are on the equipment itself. Every terminal block of a panel or cabinet must be identified with the number indicating the panel or cabinet it belongs to, the terminal strip identification followed by a number starting with 1 for the first terminal and finishing with the number of the last terminal from top to bottom or left to right. The Bidder shall arrange and identify the terminal blocks for exclusive use of Purchaser as show on enclosed drawing specific to each equipment. The Bidder must comply with this requirement.

The UPTCL will not accept any deviation nor will assume any cost resulting from drawing changes or modifications of wiring or cabling resulting from changes caused or originated by the Bidder. Wires originating from a device or terminal block shall be tagged at both ends with identification of remote end device terminal number using the symbols previously mentioned. Every cabinet or panel will be provided with a wiring drawing where all the devices are shown.

28.2 Technical Data Schedules

The Tenderer must fill out completely and attach to his proposal the Technical Data Schedules included in the technical specification of the equipment. The data shall include the values

guaranteed by the Bidder. If any data cannot be furnished at tender stage, Bidder shall assign reasons and shall confirm to provide the same at engineering stage for approval. The Bidder shall guarantee that the equipment and the works are in accordance with all the requirements of the present specification including the data from the Technical Data Schedules. The Technical Specifications for equipment represent different types and/or ratings under a single data schedule. Bidder shall however submit the data schedule for each type and/or rating of the equipment required for the project.

28.3 Instruction Manuals

Service and maintenance manuals including sequence of operation manuals must describe in details, the procedures and the operation instructions for the equipment and the measuring devices. The assembly method, commissioning guide, adjustment, operation and disassembly of every component, system or machine, must be described and illustrated in details. The manuals must include as well a troubleshooting procedure to locate rapidly the defective part. For preventive maintenance purposes, a list of verification point visual marking and measurements will be included. The frequency of inspections and maintenance of every component shall be described in the manuals.

The Bidder shall submit manuals that are clear, fully detailed and easily understood to ensure the appropriate operation and maintenance of the equipment.

The manuals shall include a copy of the "as built" drawings, the list of spare parts and a list of all the pieces of every component or item that makes up the equipment. The latter must include the Bidder identification, the manufacturing codes and the instructions to order the pieces. The manual shall also include an updated copy of the Technical Data Schedules of the equipment, as supplied. The Bidder shall submit the instruction and service manual for UPTCL's review at least one month before shop testing.

The Bidder shall include in every manual a copy of the tests performed on the equipment and all the accessories, and the corresponding results.

The Bidder shall provide for every apparatus, six (6) technical manuals, two (2) of which shall be properly wrapped and placed inside the cabinets, panels or control kiosks at time of delivery. In the case where there is no room for manuals, the two manuals shall be well placed and packed in a wooden crate.

28.4 Language

All technical documents such as: calculation schedules, curves, maintenance and service manuals, quality assurance control program report, plant tests and manufacturing schedule, drawings, nameplates and instructions manuals shall be presented by the Bidder to the UPTCL, shall be in the English language.

29 QUALITY CONTROL PROGRAMME

29.1 Programme

In general terms, the manufacturing quality programme shall be in compliance with ISO 9002 or later standards. The UPTCL reserves the right to verify the document pertaining to the manufacturer's quality assurance programme, as well as the application of the same in the manufacturing plant.

In general, the assembly of all the equipment components shall be carried out in the manufacturer's workshops so that it shall possible to perform inspections, tests, etc. that will ensure a subsequent satisfactory operation. The exceptions to this rule will only be possible upon UPTCL's consent.

The UPTCL's authorized representatives shall have the right of access to the plant and to inspect and verify the quality of materials used in the manufacturing process.

The manufacturer of each major equipment shall submit Quality Assurance Programme (QAP) for the manufacturing and testing of equipment along with the drawings to UPTCL.

29.2 Plant Tests

The materials and all the equipment shall be tested as per the prescriptions of this specification. The tests shall be performed by the Bidder and certified by the authorized representative of the UPTCL.

All the required tests must be performed in order to confirm that the materials and the equipment comply with these specifications, and to allow the UPTCL to detect any material or manufacturing defects.

The results of all the tests shall be marked down in the reports containing all the necessary information to enable verification of compliance with the present specification. The test certificates shall be written in English and shall show the results and real conditions of the tests performed the circuits, oscillogrammes, environmental conditions, nameplate drawings with measured values, graphs, etc.

No later than two (2) weeks after having performed the tests, the Bidder shall submit to the UPTCL, four (4) copies of the report of all tests as a bound document. The test reports shall indicate the tests performed, instruments used, names of test personnel and provide the witness's signature as applicable. The report must also include a description of any failure that occurred while performing the plant tests, even if the test resumed after the failure.

The tests are meant to verify and determine the characteristics of the equipment. Normally, type tests shall be performed on one (1) apparatus of each type and with different technical characteristics. If type tests have been performed on identical apparatus, within a period not exceeding 5 years from 02.03.19, the results may be accepted. The routine tests are intended to reveal any defective material or manufacture non-conformity and shall be performed on all equipment supplied.

The units to be assembled in the plant (panels, cabinets, control cabinets) shall be assembled, wired, adjusted and tested in the plant, as much as possible, under the same service conditions that will prevail at the site of installation, to ensure the accuracy of the wiring and the correct operation of the equipment.

The UPTCL reserves the right to be present at any of the tests.

The equipment to be tested must be totally assembled for an inspection before the tests. The Bidder must submit to the UPTCL a detailed program of tests for review, at least one month before the tests take place. The Bidder shall inform the UPTCL in writing, at least 30 days in advance, of the date of the tests.

29.3 Stage Inspection Programme

UPTCL and/or his representative will conduct routine and/or periodic inspection of the works and material in the manufacturing of the major equipment and construction sites in various stages of the Project. The Bidder shall provide facilities and access to the UPTCL and/or his representative to inspect the workmanship and the quality of the material, manufacturing process and the installation. The Bidder shall advise the UPTCL in writing the schedule of any such routine and/or periodic inspection. The Bidder shall attach a copy of the completed inspection checklist or final/in-process inspection report by the Bidder's QA/QC UPTCL/inspector on every inspection request submitted to the UPTCL. The Bidder's QA/QC UPTCL/inspector shall ensure that the items for inspection covered by the Bidder's "Inspection Request" are ready prior to inspection by the UPTCL and/or his representative.

30 NAMEPLATES, LABELS AND RATING PLATES

The equipment shall be fitted with nameplates and indication plates, which must be manufactured of non-corrodible stainless steel or aluminium, with a minimum thickness of 1 mm engraved black letters on a light background, and shall be fixed to the apparatus with non-busting screws. A rating plate shall be attached to each major and auxiliary item of equipment supplied. This plate shall be permanently engraved with the designed full load ratings, serial number, type number, date of manufacture, and other identification deemed necessary. Where required by the UPTCL, diagram plates shall also be supplied.

A nameplate shall be provided to identify the equipment supplied. The identifying inscription shall be approved by the UPTCL or conform to that designated in the appropriate sections of this Specification. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles, etc.

Labels shall be manufactured of non-hygroscopic material with engraving of a contrasting colour or alternatively, for indoor use, of laminated plastic material with lettering engraved. The lettering should be black against white background. The materials used shall be non-fading, non-aging type, suitable for tropical conditions.

All apparatus, motors, control gear and all panels and the apparatus contained therein, shall be labelled, indicating where necessary, their purpose and the "ON" and "OFF" positions. Upon request by the UPTCL during the approval of Nameplates and Labels, some inscriptions shall be in Hindi language.

ANNEXURE – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 765 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 220 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee

on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%,

100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off. For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects.

These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- k) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 220kV and above) shall be carried out alongwith supporting structure. The Bidder shall arrange to transport the structure from his Bidder's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

SECTION-4

NO DEVIATION CERTIFICATE

It is confirmed that there is no deviation and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and or exceptions. Further it is confirmed that at all drawings/ data sheets/ QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information/ repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL and without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company Seal

SECTION-5

Check List

1. TECHNICAL REQUIREMENTS (FOR SURGE ARRESTER)

Sl. No.	Description	Unit	624 kV SA	
1	Type		Outdoor. Heavy duty, station class, metal oxide gapless	YES/NO
2	Rated network maximum operating voltage	kVrms	800	YES/NO
3	Rated Arrester voltage (Ur)	kVrms	624	YES/NO
4	Rated continuous operating voltage as per IEC (UC)	kVrms	490	YES/NO
5	Rated discharge current (8/20 μ s)	kApeak	20	YES/NO
6	Switching impulse current (peak)	kA	2	YES/NO
7	Line discharge class (IEC 60099-4)		5	YES/NO
8	Rated frequency	Hz	50	YES/NO
9	Max. residual voltages for: - Lightning impulse current, 8/20 μ s, 20 kA	kVp	1474	YES/NO
10	Max. residual voltages for: - Switching impulse current, 30/60 μ s, 2 kA	kVp	1215	YES/NO
11	Energy dissipation capacity	kJ/kV	15.4	YES/NO
12	High current impulse withstand (4/10 μ s)	kA	100	YES/NO
13	Temporary overvoltage withstand (for 10 s)	kV	660	YES/NO
14	Housing material		Porcelain	YES/NO
15	Lightning impulse withstand voltage	kVp	≥ 2100	YES/NO
16	Switching impulse withstand voltage	kVp	≥ 1550	YES/NO
17	Power frequency withstand voltage (1min. wet)	kVrms	≥ 975	YES/NO
18	Creepage distance	mm	25mm/kV	YES/NO
19	Cantilever strength	KGM	≥ 500	YES/NO
20	Pressure relief capacity - current amplitude (rms) - X/R, asymmetry factor - current duration	kASYM - s	≥ 40 30 0,2	YES/NO
21	External radio interference voltage (RIV) RIV max. voltage level (IEC 60694) at 0,5 MHz	μ V	2500	YES/NO
22	Life Expectancy	100 years under site conditions considering effects of direct solar radiation		YES/NO
23	Suitability to Hot Line Washing			YES/NO

24	Parts/ Accessories to be supplied with SA as mentioned below but not limited to it.			YES/NO
A	Surge Counter			YES/NO
B	Insulating base			YES/NO
C	Corona ring (if applicable)			YES/NO
D	Terminal clamp suitable for Quad Bull & Twin Bersimis ACSR conductor			YES/NO
E	Hardware required for inter-unit connection and to connect the surge arrester to structure			YES/NO
F	Insulated interconnecting cable between arrester and surge monitor. (6 m for each 336SA & 9m for 624kV SA, cables for all SA at a station supplied in single length)			YES/NO

Sl. No.	Description	Unit	336 kV SA	
1	Type		Outdoor. Heavy duty, station class, metal oxide gapless	YES/NO
2	Rated network maximum operating voltage	kVrms	420	YES/NO
3	Rated Arrester voltage (Ur)	kVrms	336	YES/NO
4	Rated continuous operating voltage as per IEC (UC)	kVrms	267	YES/NO
5	Rated discharge current (8/20 μ s)	kApeak	20	YES/NO
6	Switching impulse current (peak)	kA	2	YES/NO
7	Line discharge class (IEC 60099-4)		4	YES/NO
8	Rated frequency	Hz	50	YES/NO
9	Max. residual voltages for: - Lightning impulse current, 8/20 μ s, 20 kA	kVp	897	YES/NO
10	Max. residual voltages for: - Switching impulse current, 30/60 μ s, 2 kA	kVp	728	YES/NO
11	Energy dissipation capacity	kJ/kV	10	YES/NO
12	High current impulse withstand (4/10 μ s)	kA	100	YES/NO
13	Temporary overvoltage withstand (for 10 s)	kV	396	YES/NO
14	Housing material		Porcelain	YES/NO
15	Lightning impulse withstand voltage	kVp	≥ 1425	YES/NO
16	Switching impulse withstand voltage	kVp	≥ 1050	YES/NO
17	Power frequency withstand voltage (1min. wet)	kVrms	≥ 630	YES/NO
18	Creepage distance	mm	25mm/kV	YES/NO
19	Cantilever strength	KGM	≥ 500	YES/NO
20	Pressure relief capacity - current amplitude (rms) - X/R, asymmetry factor - current duration	kASYM - s	≥ 40 30 0,2	YES/NO

21	External radio interference voltage (RIV) RIV max. voltage level (IEC 60694) at 0,5 MHz	μ V	500	YES/NO
22	Life Expectancy	100 years under site conditions considering effects of direct solar radiation		YES/NO
23	Suitability to Hot Line Washing			YES/NO
24	Parts/ Accessories to be supplied with SA as mentioned below but not limited to it.			YES/NO
A	Surge Counter			YES/NO
B	Insulating base			YES/NO
C	Corona ring (if applicable)			YES/NO
D	Terminal clamp suitable for Quad Bull & Twin Bersimis ACSR conductor			YES/NO
E	Hardware required for inter-unit connection and to connect the surge arrester to structure			YES/NO
F	Insulated interconnecting cable between arrester and surge monitor. (6 m for each 336SA & 9m for 624kV SA, cables for all SA at a station supplied in single length)			YES/NO

2. TYPE TESTS

Whether Type test reports of the tests conducted earlier (not more than five years earlier) on similar material submitted.

YES/NO

If type test report submitted, indicate report number.

If the valid type tests reports are not available with the bidder
Or type tests reports are found technically unacceptable
by customer then the type tests shall be conducted by the bidder
without cost and delivery implication to BHEL.

YES/NO