



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

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Title	360 kV SURGE ARRESTER		Date	01.05.18	01.05.18
		Group	TBEM		
CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD.					
PROJECT: 5x800 MW YADADRI TPS – 400 kV SWITCHYARD					
LOI NO: ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated: 17/10/2017					
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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 360 kV Surge Arrester complete with accessories as listed under this specification.

This section covers the specific technical requirements of Surge Arrester. This constitutes minimum technical parameters for the above item as specified by the customer (TSGENCO). 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
- Section-4: Guaranteed Technical Particulars

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 : Telangana State Power Generation Corp. Ltd.
Name of the project : 400 kV Switchyard at 5X800MW Yadadri TPS

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

a) Technical parameters of surge arrester

Sl. No.	Description	Unit	360 kV SA
1.	Rated Arrester Voltage	kV (rms)	360
2.	Rated system voltage	kV (rms)	400
3.	Highest system voltage	kV (rms)	420
4.	Rated frequency	(Hz)	50
5.	No. of poles	No.	1
6.	Design ambient Temperature	(°C)	50
7.	Type		Station class, heavy duty and gapless Zinc Oxide type
8.	Installation, Mounting		Outdoor, latticed steel structure mounted

9.	Rated lightning impulse withstand voltage for 1.2/50 μ Sec wave impulse - between line terminals and ground - for arrester housing	kVp kVp	± 1425 ± 1425
10.	Switching impulse withstand voltage - between line terminals and ground - for housing	kVp kVp	± 1050 ± 1050
11.	One minute power frequency dry withstand voltage - between line terminals and ground	kV (rms)	520
12.	Corona extinction voltage	kV (rms)	320
13.	Minimum creepage distance: Phase to ground	mm/kV	25
14.	Seismic acceleration		0.3g
15.	Partial discharge at 1.05 COV	pc	Not exceed 50
16.	System neutral earthing		Effectively Earthed
17.	Rated Nominal discharge Current of 8/20 μ Sec. wave	kA	20
18.	Minimum discharge capability	KJ/kV	12
19.	Continuous Operating voltage at 50°C	kV (rms)	292
20.	Switching surge residual voltage (1kA)	kVp	720
21.	Max. residual voltage at 20kA nominal discharge current	kVp	850
22.	Max. steep fronted wave residual voltage at 20kA	kVp	975
23.	Long duration discharge class		4
24.	High Current short duration test value (4/10 μ Sec. Wave)	kAp	100
25.	Current for pressure relief test	kA (rms)	50
26.	Low current long duration test value (2400 μ Sec.)		As per IEC
27.	Minimum Prospective fault current	kA (rms)	50
28.	Pressure Relief Class		50 kA

1.3 Quantity

A) Main Item

Sl. No.	Item	Quantity
1	360kV, 20kA, Metal-oxide, gapless type, Surge Arrester complete with insulator base and surge counter with leakage current monitor & fixing hardware to support structure.	60 Nos.
2	Terminal connector for 360kV Surge Arrester suitable for Twin Moose ACSR conductor	60 Nos.

3	Insulated connecting cable between surge arrester and surge monitor (single length)	360m
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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 twin moose ACSR 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	360kV, 20kA, Metal-oxide, gapless type, Surge Arrester complete with insulator base and surge counter with leakage current monitor	6 Nos.

1.4 Pre-qualification Requirement

400kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of single phase Surge Arrestors of offered voltage class or higher, suitable for air insulated substation/switchyard and which must have been in successful operation for a minimum period of two (2) years as on zero date of Yadadri (17.10.2017).

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 zero date of Yadadri (17.10.2017). The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from 17.10.2017) or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

In addition to type test report, test reports of following special tests shall be provided.

- Special thermal stability tests to be conducted on lightning arresters according to IEC, as an acceptance test.
- Temperature cycle test on the porcelain housing of the arrester to be conducted as per IS/IEC.
- The artificial pollution test shall be carried out as per applicable standards.
- The galvanisation test on metal parts shall be carried out as acceptance test.
- The functional (operational) acceptance tests shall be carried out on the surge counter.

1.6 INSPECTION & TESTING

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

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 : 400 kV Switchyard at 5X800MW Yadadri TPS
- b) Customer Name : Telangana State Power Generation Corp. Ltd.
- c) Consultant Name : TCE, Bangalore
- d) Contractor : BHEL
- e) Customer LOA no. : ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated: 17/10/2017

1.10 Drawings / Documents

In addition to no. of sets of documents to be submitted to customer (refer section 3), two sets of all documents submitted for approval / information and five sets of all approved documents shall be provided for BHEL use.

Soft copies in CD-R of documents shall comprise

- i) Scanned images of all approved documents, including drawings.
- ii) Editable versions (AUTO CAD 2000 or High) of all drawings viz. drawings, GTP, Manufacturing and field quality plan, type test reports, O & M instructions / manuals.

SECTION - 2

EQUIPMENT SPECIFICATION

- 2.0 Arresters shall be designed with sufficient cantilever strength to meet with stress due to wind pressure and short circuit forces arising from rated short time current.

The lightning arrester shall be installed as close to the equipment as possible and also on the line entrance.

Lightning arrester shall be station class, heavy duty, metal oxide gapless type with ratings as detailed in the document.

The arrester shall be suitable to protect the equipment having insulation level as indicated in the document.

The arrester shall be capable of discharging over-voltages occurring during switching of unloaded transformer, reactor and long line

The arrester shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.

2.1 Constructional Features

- i) The arrester shall be single pole, hermetically sealed, with non-linear blocks of sintered metal oxide material so as to obtain a robust construction with excellent electrical, thermal and mechanical characteristics even after repeated operation.
- ii) Insulator shall be wet process porcelain, brown glazed and free from imperfections. All metal parts and hardware shall be hot dip galvanised.
- iii) Creepage distance shall correspond to that specified in the annexure. Grading ring, if required, shall be provided to maintain voltage gradient within permissible limit.
- iv) The arrester shall be provided with pressure relief device to prevent shattering of porcelain in case excessive gas pressure builds up.

2.2 Accessories

- i) Lightning arrester shall be furnished complete with insulating base, arrester disconnector, surge counter, leakage current monitor and anchoring hardware for mounting on steel structure.
- ii) A leakage current detector shall be furnished with the counter as an integral part. This is for monitoring the leakage to indicate any possible breakdown.
- iii) Surge counter and leakage current meter shall be housed in an IP 55 enclosure and their reading shall be visible through inspection glass panel in the front.

- iv) The surge counter shall be suitably enclosed for outdoor duty and be mounted at a convenient height for reading. Counter terminals shall be such as to permit connections with minimum possible bends. The mounting arrangement shall be such that it can be tilted 45 degree from horizontal plane for convenient of reading. No auxiliary power supply or battery shall be required for operation of counter.
- v) A suitably sized by-pass shunt along with necessary terminals shall be furnished for bypassing the discharge counter if required.
- vi) Grading ring/corona ring as applicable for the particular voltage class of arrester shall be provided.

2.3 Terminals

- i) All connection terminals shall be of corrosion resistant material and complete connection hardware.
- ii) High voltage line terminal shall be provided with bimetallic terminal connector suitable for connection to the type and size of conductor indicated in annexure.
- iii) All ground terminals shall have provision of connection to 75 x 10 mm G.I. flat.

2.2 CODES AND STANDARDS

IEC : 99-4(1991)	Metal oxide surge arresters without gaps for AC systems
IS 2633 :1986	Method for testing uniformity of coating of Zinc coated articles
IS 2629 : 1985	Recommended practice for hot-dip galvanizing on iron & steel
IS 3070 (Part II): 1993	Surge Arrester for AC Systems: Metal oxide lightning arresters with no gaps
IS 4759 : 1984	Hot dip Zinc coating on structural steel and other allied products.
IS 5561:1970	Electric power connectors
IS 5621: 1980	Hollow insulator for use in electrical equipment
IS 6745: 1972	Method for determination of mass of zinc coating on iron and steel articles.

ANNEXURE-B

FITTINGS & ACCESSORIES

Lightning arrester

Each Lightning Arrester shall be furnished complete with the accessories as listed below:

1. Insulating Base with anchoring bolts, nuts etc. for fixing the equipment on to structure.
2. Surge counter with integral leakage current monitor.
3. By-pass shunt with connection provision.
4. Clamp type bimetallic terminal connectors.
5. Ground terminals.
6. Grading ring, if necessary.
7. 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.



Project: 5x800 MW YADADRI THERMAL POWER STATION.
Customer: TELANGANA STATE POWER GENERATION CORPORATION LTD

Section-3: Project Details & General Specifications

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SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

GENERAL TECHNICAL REQUIREMENTS

1.0 PROJECT DETAILS

Customer	:	M/s Telangana State Power Generation Corporation Ltd.
Project Title	:	5x800MW Yadadri Thermal Power Station
Project Location	:	Veerlapalem Village, Damercherla Mandal, Nalgonda District, Telangana
Nearest Railway station	:	Vishnupuram railway station.
Nearest Road Head	:	NH-9 is at 45km North SH-2 is at 7km South
Nearest Airport	:	Hyderabad (about 120 Km) Chief Engineer (O&M), 5X800MW Yadadri Thermal Power
Postal Address	:	Station, TSGENCO, Village - Veerlapalem, Mandal- Dameracheral, Dist. – Nalgonda, Telangana

1.1 SITE CONDITIONS (FOR DESIGN PURPOSES)

1.1.1 SITE CONDITIONS

a).	Average rainfall per year	:	1124 mm
b).	Maximum hourly rainfall intensity	:	102 mm
c).	Altitude	:	1000 m

1.1.2 DESIGN AMBIENT

a).	Minimum Temperature	:	13.5°C
b).	Maximum Temperature	:	45°C
c).	Design Ambient Temperature	:	50 °C

1.1.3 RELATIVE HUMIDITY

a).	Maximum	::	85%
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Project: 5x800 MW YADADRI THERMAL POWER STATION.
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Section-3: Project Details & General Specifications

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1.1.4 WIND PRESSURE (AS PER IS:875-1987)

a). Design wind speed : 44 m/sec.

1.1.5 SEISMIC FACTORS

a). Horizontal Seismic Coefficient : As per latest IS : 1893
b). Vertical Seismic Coefficient : As per latest IS : 1893 } *Zone – III*

1.1.6 ELECTRICAL DATA

		400 kV System	415V AC System	240V AC System	220 V DC System	48 V DC System
1.	Nominal Voltage	400 kV	415 V	240 V	220 V	48 V
2.	Highest System Voltage	420 kV	457 V	264 V	242 V	55 V
3.	No. of phases	3	3	1	NA	NA
4.	Frequency	50 Hz	50 Hz	50 Hz	NA	NA
5.	Voltage variation	± 5%	± 10 %	± 10 %	+10 % to -15%	± 10 %
6.	Neutral Earthing	Effectively Earthed	Solidly Earthed	Solidly Earthed	-	-
7.	Fault Level	50 kA for 1 sec.	50 kA for 1 sec.	50 kA for 1 sec.	15 kA for 1 sec.	-

1.1.7 SYSTEM PARAMETERS

Dry and wet one minute power frequency withstand voltage : 630 kVrms
Dry impulse withstand voltage positive and negative : 1425 kVpeak
Minimum Total Creepage : 25 mm/kV

1.1.8 MINIMUM CLEARENCE (AS PER IS: 10118)

Phase to phase (PP) : 4200 mm
Phase to earth (PE) : 3500 mm
Section clearance : 6500 mm
Minimum ground clearance from plinth level (Plinth level : 300 mm) : 8000 mm



Project: 5x800 MW YADADRI THERMAL POWER STATION.
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Section-3: Project Details & General Specifications

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Vertical ground clearance to nearest part not at earth
potential of an insulator supporting live conductor/ equipment 2440 mm

1.2 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 recognised that the Manufacturer may have standardised 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.

1.3 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.



1.4 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. Purchaser reserves the option for getting any or all the type tests repeated on the equipment. 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 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.

The purchaser intends to repeat the type tests and additional type tests on cables for which test charges shall be payable as per provision of contract.

The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractors premises or Works and shall have the power, at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Manufacturer's own premises or works. 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 Manufacturer shall give the Purchaser/inspector thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Manufacturer's account except for the expenses of the inspector. Unless witnessing of the tests is virtually waived, the Purchaser/ inspector will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Manufacturer may proceed with the test which shall be deemed to have been made in the Inspector's presence and the Manufacturer shall forthwith forward duly certified copies of test reports in triplicate to the Inspector.

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 this test 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 will have the right of having at his own expenses any other test(s) of reasonable nature carded out at Manufacturer's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

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.

1.5 MATERIAL/WORKMANSHIP

1.5.1 GENERAL REQUIREMENT

Where the specification does not contain characteristics with reference 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 purposes 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 and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil 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 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 be interchangeable with, 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 construed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, 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 manufacture's limits. Suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor 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 Contractor 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 Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If 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 Contractor. The same shall be applicable to other consumables too.

1.5.2 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.

1.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The contractor shall propose a colour scheme for those equipment/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 on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

1.7 PAINTING

- a) All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of practice for Phosphating Iron and Steel".
- b) Oil, grease, dirt and swerve shall be thoroughly removed from emulsion by cleaning.
- c) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- d) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and over drying.
- e) The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "Flash dried" while the second coat shall be stoved.
- f) After application of the primer, two coats of finishing epoxy paint shall be applied, each coat followed by stoving. The panel shall have colour conforming to shade 631 of IS-5 for outside and inside of the panel with black colour for base frame.
- g) Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.



- h) Finished painted appearance of panel shall present an asthetically pleasing appearance free from dents and uneven surface.
- i) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

1.8 PROTECTION

- a) All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.
- b) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.
- c) The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.
- d) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

1.9 FUNGISTATIC VARNISH

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

1.10 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 other wise 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.



1.11 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised 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 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

1.12 AUXILIARY POWER SUPPLY

1.12.1 A.C power supply for auxiliaries will be available at 240 V, 50 C/s 1-phase, 2 wire and 415V, 50 C/s, 3-phase, 4 wire, neutral solidly earthed with variation in frequency of +/-5% and variation in voltage +/-10%

1.12.2 D.C. power supply at 220 V, 2-wire ungrounded will be available 187 V to 242 V.

1.13 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of purchaser. Wherever equipment similar to the one being offered has already been type tested within 5 years from the date of opening the bid. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

1.14 PACKAGING

Aluminium Tube shall be partially packed with Hessians cloths. Similar items shall be grouped and tied with steel wires/strip for convenient handling during transits.

MARKINGS

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.



e) Tare weight.

f) Gross weight.

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 Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/material at a later date, 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 account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage wagons and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

1.15 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser.

Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the contractor at his own expenses.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the



purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the Contractor' account.

The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance to the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of such nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipments which require indoor storage.

The words erection and installation used in the specification are synonymous. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

1.16 TOOLS AND TACKLES

The Contractor 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.

1.14 EQUIPMENT BASES

A cast iron or welded steel base-plate shall be provided for all rotating equipment, which is 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 a neat design with pads for anchoring the units shall have a raised lip all around, and shall have threaded drain connections.

1.15 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.



1.16 DOCUMENTATION

1.16.1 DRAWINGS

All drawings shall be prepared in AutoCAD and ultimate documentation would include drawings/documents on CDs. All dimensions and data shall be in SI metric units.

All items of the equipment should be clearly identified by proper part nos. in the contract drawings. Such parts, which are to be dispatched to site from works in dispatchable units and are reassembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. The shipping list should be sent along with the general arrangement drawings for engineer's approval. All the items of the shipping list should be identified in the drawing.

The drawing submitted by the supplier shall be reviewed by the purchaser as far as practicable within two weeks of receipt of drawings and shall be modified by the sub-contractor if any modifications and/or corrections are required by the purchaser. The sub-contractor shall incorporate such modifications and / or corrections and submit the final drawings for approval. Any delay arising out of failure of the subcontractor to rectify the drawings shall not alter the contract completion date.

Further work by the subcontractor shall be in strict accordance with these drawings and no deviation shall be allowed without the written approval of the purchaser.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at supplier's risk.

Approval of drawing or work by the purchaser/consultant shall not relieve the subcontractor of any of his responsibilities and liabilities under the contract.

In case of any modifications that may be necessary during erection or commissioning of the equipment, the subcontractor shall carry out modifications in the original drawing & submit 'As Built drawings' and required no. of prints thereof.

1.16.2 INSTRUCTION MANUALS

The supplier shall submit to the purchaser, draft instruction manuals for approval within 30 days of placement of order. The final instruction manuals complete in all respects shall be submitted 60 days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing, operation & maintenance procedures of the equipment.

If after the commissioning and initial operation of the plant, the instruction manuals require any modification/ addition / changes, the same shall be incorporated and the up- dated final instruction manuals shall be submitted as required.



1.16.3 TITLE BLOCK & DRAWING/ DOCUMENT NUMBERING SCHEME

Title block for drawing / document should be followed as per ANNEXURE-3

1.16.4 DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A.	<u>For approval</u>	<u>No of Copies</u>
	Copies of all drawings with project details, dimension, shipping weights, No. of cases & dimensions, fixing details, tolerance etc.	10
	Copies of type test reports.	5
	Copies of works quality plan & field quality plan.	5
	Copies of installation, operation & maintenance manual.	5
	Copies of drawings on floppies/CDs	1 set
B.	<u>After approval and for information / distribution</u>	
	Copies of all drawings	15
	Copies of installation, operation & maintenance manual including Routine test reports	15
	Sets of RTF of drawings	2
	CDs of Drgs and O & M Manuals	4
C.	<u>As Built Drawings</u>	
	Hard copies of Drawings	15
	CDs	4
	NOTE:	
1.	Any revision of drawings / documents shall be submitted in the same no. of copies submitted first time for approval	
2.	Final drawings / documents shall be submitted in bound volume with customer and project details etc. written on the top.	

SECTION - 4

GUARANTEED AND TECHNICAL PARTICULARS

1.0 GENERAL

- a) Manufacturer's Name
- b) Manufacturer's type designation
- c) Applicable standards

2.0 ELECTRICAL CHARACTERISTICS

- a) Arrester class and type
- b) Rated arrester voltage (kV)
- c) Maximum continuous operating voltage (COV) at design ambient temperature
- d) Nominal discharge current (8/20 micro sec. Wave) (kA)
- e)
 - i) Minimum discharge capability (kJ/kV) referred to rated voltage at minimum of discharge characteristics
 - ii) Line Discharge class, as per IEC
- f) Maximum equivalent front of wave protection level (discharge voltage with 0.5 x 1.5 micro sec. 10 KA impulse current)
- g)
 - i) Minimum switching surge residual voltage, at 1 KA (kVp)
 - ii) Maximum switching surge residual voltage at 1 kA (kVp)
- h) Maximum residual voltage for 8/20 micro sec current wave
 - i) at 50% nominal discharge current (kVp)

- ii) at 100% nominal discharge current (kVp)
- iii) at 200% nominal discharge current (kVp)
- I) One minute power frequency(dry) withstand voltage of arrester (kV rms)
- j) Impulse withstand test voltage of arrester housing with 1.2/50 micro sec wave, (kVp)
- k) Impulse current withstand
 - i) High current short duration (4/10 micro sec. Wave) kAp
 - ii) Low current long duration (A peak)
- l) Maximum internal ionisation at 50 Hz voltage equal to
 - i) 1.05 COV
 - ii. 1.0 COV
- m) Reference voltage and corresponding reference current of arrester
- n) Maximum internal leakage current at (W/kV)
 - i) COV
 - ii) 1.1 COV
 - iii. COV at 150 deg. C
 - iv. Reference voltage
- o) Pressure relief class
- p) Are the protection levels affected by pollution of external insulation
- q) Energy absorption capability in kJ per operation of the arrester, during a switching surge discharge

- r) Maximum amount of energy that may be dispatched into the arrester during discharge assuming that discharge takes place within 1 min period and state the switching surge current
- s) Internal pressure required to operate pressure relief device as a percentage of burst pressure of porcelain
- t) Dynamic over voltage withstand kVp
 - i. For 3 peaks
 - ii. For 0.01 sec.
 - iii. For 0.1 sec.
 - iv. For 1 sec.
- u) Minimum prospective symmetrical fault current
- v) Rejection rate of ZnO blocks during manufacturing and operation for the past three years (%) separately
- w) Rated voltage of ZnO disc (kV)
 - I) No. of ZnO discs in a unit
 - ii. No. of units/ arrester
 - iii) Height/ Thickness of ZnO discs (mm)
 - iv) Diameter of ZnO disc (mm)

3.0 EXTERNAL INSULATION

- a) Type
- b) Applicable standard

- c) Impulse voltage withstand test voltage of housing with 1.2/50 microsec wave (kVp)
- d) One minute power frequency withstand voltage of arrester housing dry & wet (kV rms)
- e) Total creepage distance of arrester housing (mm)
- f) Cantilever strength of complete arrester (kg)

4.0 OVERALL DIMENSIONS

- a) Overall dimensions
 - i. Overall Height (mm)
 - ii. Height upto top of terminal pad from mounting plane
 - iii. Material of terminal pad
 - iv. Size of terminal pad
 - v. Mounting dimensions and diameter of mounting holes
 - vi. Diameter of insulator
- b) Total weight of complete arrester (kg)

ANNEXURE – A

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-6

Check List

1. TECHNICAL REQUIREMENTS (FOR SURGE ARRESTER)

S. No.	PARTICULARS	Unit	360 kV	
1	Designation	-	Heavy duty, Station class	YES/NO
2	Application	-	Surge protection of transformer/ line / bus bar	YES/NO
3	Type	-	Station class gapless zinc oxide type	YES/NO
4	Installation	-	Outdoor	YES/NO
5	Arrester Rated Voltage	kV	360	YES/NO
6	Max. Cont. Operating Voltage (MCOV) at 50°C	kV	292	YES/NO
7	Rated Frequency	Hz	50	YES/NO
8	Rated nominal discharge current for 8/20 μ s wave	kA	20	YES/NO
9	Minimum discharge capability	kJ/kV	12	YES/NO
10	Switching surge residual voltage (1 kA)	kV _p	720	YES/NO
11	Max. residual voltage at 10kA nominal discharge current	kV _p	780	YES/NO
12	Max. residual voltage at 20kA nominal discharge current	kV _p	850	YES/NO
13	Max. steep fronted wave residual voltage at 20kA	kV _p	975	YES/NO
14	One minute dry/ wet power frequency withstand test voltage for arrester housing	kV _{rms}	630	YES/NO
15	Impulse withstand Voltage of arrester housing (1.2/50 ms wave) Dry and wet	kV _p	± 1425	YES/NO
16	Long duration discharge class		4	YES/NO
17	High current short duration test value (4/10 μ s wave)	kA _p	125	YES/NO
18	Current for pressure relief test	kA _{rms}	50	YES/NO
19	Current for long duration test (2000 μ s)	A	As per IEC	YES/NO
20	Min. total creepage distance	mm	10500	YES/NO
21	Switching impulse withstand Voltage of arrester housing (1.2/50 μ s wave) Dry and wet	kV _p	± 1050	YES/NO

S. No.	PARTICULARS	Unit	360 kV	
22	Prospective symmetrical fault current for 3 sec	kA	50	YES/NO
23	Pressure relief class		50 kA	
24	RIV at specified power frequency voltage	μ V	Less than 1000 at 266 kV _{rms}	YES/NO
25	Partial discharge at 1.05 MCOV	pC	Not more than 50	YES/NO
26	Life Expectancy		100 years under site conditions considering effects of direct solar radiation	
27	Suitability to Hot Line Washing			
28	Parts/ Accessories to be supplied with SA as mentioned below but not limited to it.			
i)	Surge Counter			YES
ii)	Insulating base			YES
iii)	Corona ring (if applicable)			YES
iv)	Terminal clamp suitable for Twin Moose ACSR conductor			YES
v)	Hardware required for inter-unit connection and to connect the surge arrester to structure			YES
vi)	Insulated interconnecting cable between arrester and surge monitor. (6 m for each SA, cables for all SA at a station supplied in single length)			YES

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