BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
ENGINEERING MANAGEMENT

BHEL Document No.	Rev 02		Prepared by	Checked by	Approved by
TB-350-316-003		Name	MM	DKM	RS
Type of Document **TECHNICAL SPECIFICATION**		Sign	-sd-	-sd-	-sd-
Title **390, 120 & 30 kV Surge arresters**		Date			
		Group	**TBEM**		

Customer	**NABINAGAR POWER GENERATION CO. LTD.**
Projects	400/132/33 kV s/s at Nabinagar STPP (3x660 MW)

CONTENTS

Note: Offers without checklist will not be considered

Rev No.	Date	Altered	Checked	Approved	
02	31.05.13	MM Mund	RS Rakesh 31/5/13		• Section 1 - Item description revised • Section 6 - Sl. No. 9 revised for 120 kV SA.
01	20.07.12	MM	DKM		Section 1 revised. Leakage current analyser deleted.

Distribution

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 gapless, metal oxide Surge Arrester complete with accessories as listed in clause 1.2 & 1.3 below.
This section covers the specific technical requirements of metal oxide Surge Arrester. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.
No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-1.

1.1 The equipment is required for the following project.

Name of Customer : **Nabinagar Power Generation Co. Pvt. Ltd. (JV between NTPC and Bihar State electricity Board)**

Name of Project : **400/132 kV Switchyard at Nabinagar STPP and extn. at 400 kV Nabinagar TPP (BRBCL)**

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 TECHNICAL PARAMETERS

As per section 2

1.3 QUANTITIES AND ACCESSORIES REQUIRED

S. NO.	DETAILS	Unit	QUANTITY	
			Nabinagar STPP (main+spare)	Nabinagar TPP (BRBCL)
1.3.1	**MAIN QUANTITIES**			
1	SURGE ARRESTER 390 KV, 10 KA,CLASS-3, 8 KJ/KV COMPLETE WITH SURGE MONITOR, INSULATING BASE, TERMINAL CONNECTORS AND ACCESSORIES	Nos.	45+2	6
2	SURGE ARRESTER 120 KV, 10 KA,CLASS-3, 5 KJ/KV COMPLETE WITH SURGE MONITOR,INSULATING BASE, TERMINAL CONNECTORS AND ACCESSORIES	Nos.	30+2	0
3	SURGE ARRESTER 30 KV, 10 KA,CLASS-3, 5 KJ/KV COMPLETE WITH SURGE MONITOR,INSULATING BASE, TERMINAL CONNECTORS AND ACCESSORIES	Nos.	12+1	0

Note: Accessories to be as per clause 1.3.2 below.
Prices of accessories shall be included in equipment price.

1.3.2 ACCESSORIES REQUIRED

1. Insulating base	: Yes
2. Surge Monitor (Millimeter +surge counter)	: Yes
3. HV Power connector	: Yes, in case of integral arrangement. To be suitable for twin MOOSE ACSR conductor for 390kV and single MOOSE ACSR conductor for 120KV and single AAAC conductor (7/4.26, 12.78 mm OD) for 33 kV.
4. Corona grading ring	: Yes
5. Insulated interconnecting cable between arrester and surge monitor. **(390 kV SA- 4m, 120/30 kV SA - 3m)**	: Yes, in single length for all SA.
6. Hardware for bolting the arrester units (Inter-unit fixing)	: Yes
7. Hardware for Fixing the surge arrester & surge monitor to structure	: Yes
8. Bypass shunts	: Yes, if required
9. Type tests required to be carried out on the arrester in the scope of supply	: No, if relevant type test certificates are available

1.4 QUALIFYING REQUIREMENT

390 KV SURGE ARRESTERS

390 kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied at least fifteen (15) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 390 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening

120 KV SURGE ARRESTERS

120 kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied atleast fifteen (15) nos. of single phase Surge Arrestors suitable for Air Insulated Substation/ Switchyard of 120 kV or above class which must have been in successful operation for a minimum period of two (2) years as on the date of bid opening.

1.5 TYPE TESTS

Bidder shall submit valid type test reports of the tests (as per relevant IS/IEC) carried out within last ten years from the date of bid opening i.e. **29.06.2011**. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the bidder.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

In case type test reports are more than 10 years old (from the date of bid opening i.e. 29.06.2011) OR the reports of type tests are found to be technically unacceptable, the type test shall be conducted without cost and delivery implication to BHEL/NTPC.

SECTION 2

EQUIPMENT SPECIFICATION

- **NTPC specification for Surge Arrester –Chapter E4**

CHAPTER- E4: SURGE ARRESTORS

1.00.00	**GENERAL**
1.01.00	The surge arrestors shall conform in general to IEC-60099-4 and IS:3070 except to the extent modified in the specification and shall be in accordance with requirements under Part-I.
1.02.00	Arrestors shall be hermetically sealed units, self supporting construction, suitable for mounting on lattice/tubular type support structures.
2.00.00	**DUTY REQUIREMENTS**
2.01.00	The Surge Arresters (SAs) shall be capable of discharging over-voltages occurring due to switching of unloaded transformers, reactors and long lines.
2.02.00	The reference current of SAs shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. Values and calculations shall be furnished with offer.
2.03.00	The SAs shall be fully stabilised thermally to give a life expectancy of one hundred (100) years under site conditions and take care of effect of direct solar radiation.
2.04.00	The SAs shall be suitable for circuit breaker duty cycle in the given system.
2.05.00	The SAs shall protect power transformers, circuit breakers, disconnecting switches, instrument transformers, shunt reactors, etc with insulation levels specified in this specification. The Contractor shall carry out the insulation coordination studies for deciding the exact location and quantity of the SAs.
2.06.00	The SAs shall be capable of withstanding meteorological and short circuit forces under site conditions.
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	Each Surge Arrester (SA) shall be hermetically sealed single phase unit.
3.02.00	The non linear blocks shall be sintered metal oxide material. The SA construction shall be robust with excellent mechanical and electrical properties.
3.03.00	SAs shall have pressure relief devices and arc diverting ports suitable for preventing shattering of porcelain housing and to provide path for flow of rated fault currents in the event of SA failure.

Clause No.	TECHNICAL REQUIREMENTS	
3.04.00	The SA shall not fail due to porcelain contamination.	
3.05.00	Seals shall be effectively maintained even when SA discharges rated lightning current.	
3.06.00	Porcelain shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage upto maximum design value for SA. The cantilever strength of the insulator shall be minimum 500kg.	
3.07.00	The end fittings shall be non-magnetic and of corrosion proof material.	
3.08.00	The Contractor shall furnish the following: a) The heat treatment cycle details with necessary quality checks used for individual blocks alongwith insulation layer formed across each block. b) Metalizing coating thickness for reduced resistance between adjacent discs alongwith procedure for checking the same. c) Details of thermal stability test for uniform distribution of current on individual discs. d) Detailed energy calculations to prove thermal capability of discs.	
4.00.00	**FITTINGS AND ACCESSORIES**	
4.01.00	Each SA shall be complete with insulating base for mounting on structure.	
4.02.00	SAs shall be provided with grading and/or corona rings as required.	
4.03.00	Self contained discharge counters, suitably enclosed for outdoor use (IP:55 degree of protection) and requiring no auxiliary or battery supply shall be fitted with each SA alongwith necessary connections to SA and earth. Suitable leakage current meters shall also be supplied in the same enclosure. The reading of milliammeter and counter shall be visible through an inspection glass panel to a man standing on ground. A pressure relief vent/suitable provision shall be made to prevent pressure build up.	
4.04.00	The Contractor shall also supply micro-processor based portable maintenance equipment for monitoring resistive current of SA as listed in part-I.	
5.00.00	**PARAMETERS**	
5.01.00	**General**	
a)	System neutral earthing	Effectively earthed
b)	Installation	Outdoor

Clause No.	TECHNICAL REQUIREMENTS	
c)	Discharge Current i) Nominal discharge current	10 kA of 8/20 microsec. wave
	ii) Discharge current at which insulation coord. is done	20 kA of 8/20 microsec. wave
d)	Rated frequency	50 Hz
e)	Long duration discharge class	3
f)	Current for pressure relief test	50/40kA rms for 400/132kV resptly.
g)	Prospective symmetrical fault current	50/40 kA rms for 1 second for 400/132kV resptly.
h)	Low current long duration test value (2000 micro sec.)	800 A
i)	Pressure relief class	Class A of Table VII of IS:3070 or equivalent IEC.
j)	Partial discharge at 1.05 MCOV (Continuous operating voltage)	Not more than 50 p.C.
k)	Siesmic acceleration	0.3 g horizontal
l)	Reference ambient temp.	50 deg. C
5.02.00	**400 kV class Surge Arrestor**	
a)	Rated system voltage	420 kV
b)	Rated arrestor voltage	390 kV
c)	Minimum discharge capability	8 kJ/kV or corresponding to minimum discharge characteristics given in clause m) below whichever is higher.
d)	Continuous operating voltage (COV) at 50 deg. C	303 kV rms
e)	Min. Switching surge residual voltage (1 kA)	730 kVp minimum, 780 kVp maximum

f)	Maximum residual voltage at	
	i) 10kA nominal discharge current	900 kVp
	ii) 20kA nominal discharge current	975 kVp
g)	Steep fronted wave residual voltage at 10kA	1050 kVp
h)	High current short duration test value (4/10 microsec. wave)	100 kAp
i)	One minute dry/wet power frequency withstand voltage of arrestor housing	630 kV (rms)
j)	Impulse withstand voltage of arrestor Housing with 1.2/50 micro sec. wave.	1425 kVp
k)	RIV at 266 kV (rms)	Less than 1000 micro volts

l) The surge arrestors are provided to protect the following equipment whose insulation levels are indicated in the table I given below. The contractor shall carry out the insulation coordination studies for deciding the location of the surge arrestors.

TABLE – I

S.NO.	EQUIPMENT TO BE PROTECTED	INSULATION LEVEL	
		LIGHTNING IMPULSE (kVp) FOR 400 KV SYSTEM	SWITCHING SURGE 250/2500 (kVp) FOR 400 kV SYSTEM
1.	Power Transformer	± 1300	± 1050
2.	Instrument Transformer	± 1425	± 1050
3.	Reactor	± 1300	± 1050
	CB/Isolator		

	- Phase to ground	± 1425	± 1050
	- Across open contacts	± 1425 (± 240)	± 900 (± 340)

m) Surge arrestors shall be capable of discharge on severe re-energisation switching surges on a 400 kV line upto 450 km. length with surge impedance of 300 ohms and capacitance of 11986 nF/km amd over voltage factor of 2.3 p.u.
Surge arrestor shall be capable of discharging energy equipment to class 3 of IEC for a 420 kV system on two successive operations followed immediately by 50 Hz energisation with a sequential voltage profile as specified below:

705 kVp for 3 peaks
580 kVp for 0.1 second
565 kVp for 1 second
550 kVp for 10 seconds

n) 400 kV line circuit breakers are equipped with closing resistor of 400 ohms with pre insertion time switching over voltage to 2.3 p.u.

5.03.00 **132 kV CLASS SURGE ARRESTOR**

a)	Rated System voltage	145 kv
b)	System neutral earthing	effective earthed
c)	Installation	Outdoor
d)	Rated arrestor voltage	120 kV (Not less than)
e)	Nominal discharge current	10 kA of 8/20 micro sec.
f)	Rated frequency	50 Hz
g)	Minimum discharge capability	5 kilo joule/kV (referred to rated arrestor voltage corresponding to minimum discharge characteristics)
h)	Continuous operating voltage at 50^0 C.	102 kV (rms)

Clause No.	TECHNICAL REQUIREMENTS	
i)	Maximum switching surge residual voltage (1 kA)	280 kVp
j)	Max. residual voltage at	
	i) 5 kA ii) 10 kA	310 kVp 330 kVp
k)	Max. steep current residual voltage at 10 kA	370 kVp
l)	Long duration discharge class (2 successive shots)	3
m)	Low current long duration test value (2000 micro sec.)	As per IEC
n)	High current short duration test value (4/10 micro sec.)	100 kAp
o)	Current for pressure relief test	40 kA (rms)
p)	One minute power frequency withstand voltage of arrestor housing (dry and wet)	275 kV (rms)
q)	Impulse withstand voltage of arrestor housing with 1.2/50 micro sec. Wave	650 kV (Peak)
r)	Pressure relief class	Class A of Table VII of IS: 3070 Part-I
s)	Radio interference voltage at 92kV	Not more than 1000 micro volt
t)	Seismic acceleration	0.3g horizontal
u)	Partial discharge at 1.05 MCOV (continuous operating voltage)	Not more than 50 p.c.

The surge arrestors are being provided to protect the following equipment whose insulation levels are indicated in the Table – I given below :

TABLE – I

SL.NO.	EQUIPMENT TO BE PROTECTED	INSULATION LEVEL
		LIGHTNING IMPULSE (kVp) FOR 132 kV SYSTEM
1.	Power Transformer	± 550
2.	Instrument Trf.	± 650
3.	CB/Isolator	
-	Phase to ground	± 650
-	Across open contacts	± 650

5.04.00 **33 kV class Surge Arrestor**

a)	Rated system voltage	33 kV
b)	Rated arrester voltage	30 kV
c)	Nominal discharge current	10 kA of 8/20 micro-sec wave
d)	Minimum discharge capability	5kJ/kV (referred to rated arrester voltage corresponding to min. discharge characteristics)
e)	Maximum continuous operating voltage at 50 deg C.	24 kV rms
f)	Max. residual voltage (1 kA)	70 kVp
g)	Max. residual voltage at 10kA nominal discharge current (8/20 micro-sec wave)	85 kVp

Clause No.	TECHNICAL REQUIREMENTS	
h)	Max. switching impulse residual Voltage at 500A peak	70 kVp
i)	Max. steep current residual voltage At 10kA	93 kVp
j)	Long duration discharge class	3
k)	High current short duration test Value (4/10 micro-sec wave)	100 kAp
l)	Current for pressure relief test	25 kA rms
m)	Low current long duration test Value (2000 micro-sec)	As per IEC
n)	Prospective symmetrical fault current	25 ~~40~~ kA for 1 sec.
o)	Pressure relief class as per IEC 99	A
p)	Insulation withstand voltage i) Dry & wet power frequency ii) Lightning impulse	 70 kV rms 170 kVp
6.00.00	Surge Arrestors shall conform to all type tests as per IEC and shall be subjected to routine and acceptance tests in accordance with IEC-60099-4. The resistive current drawn by the arrestor for at rated voltage shall be indicated in the routine test report.	

SECTION- 3

PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

3.0 GENERAL

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

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

3.1 PROJECT INFORMATION:

	Particular	Details	
a)	Customer	**Nabinagar Power Generating Company Ltd. (NPGC)** (A joint venture of NTPC Ltd. and Bihar State Electricity Board)	
b)	Project Title	400/132 kV Switchyard including 400 kV & 33 kV Transmission Lines for Nabinagar Super Thermal Power Project (3X660 MW) at Nabinagar Bihar and extension of two line bays at 4X250MW Nabinagar TPP.	
c)	Location	**Nabinagar STPP** (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar	**Nabinagar TPP (BRBCL)** (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar
d)	Nearest Road Head	National Highway-2 (Approximately 25 kms from National highway)	
e)	Nearest Rail Head	Dehri-On-Sone (Approximately 30 kms from Railway Station)	
SITE CONDITIONS			
a)	Max. ambient air temp.	50°C	
b)	Min. ambient air temp.	0°C	
c)	Max. design ambient temp.	50°C	
d)	Design reference RH	100 %	
e)	Altitude	<500 MSL	
f)	Pollution Severity	High Pollution level (25mm/kV)	
g)	Seismic Zone	Zone-III	
WIND DATA			
a)	Basic Wind speed	47m/sec	
b)	The risk co-efficient (K1)	1.07	
c)	Category of terrain	Category-2	

d)	Maximum wind pressure on steel members	1500 N/m2

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	**400 kV**	**132 kV**	**33 kV**
1	Highest system voltage	420 kV rms	145 kVrms	36 kVrms
2	Lightning Impulse voltage	±1425kVp	± 650kVp	± 170kVp
3	Switching impulse voltage	±1050kVp	--	--
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	275 kV(rms)	70 kV(rms)
5	Max. fault level (1 sec.)	50 kA	31.5kA	25 kA
6	Minimum creepage distance	10500 mm	3625mm	900 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50±5%	3	Solidly Earthed
2	240V	±10%	50±5%	4	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

The minimum height of equipment supports shall be 2550mm. The various minimum heights of the switchyard shall be as given below from plinth level :

Voltage	Equipment /1st Level	2nd Level	3rd Level
132kV	4600mm	8500mm	12500mm
400kV (1½ breaker	8000mm	16000mm	--

3.2 INSTRUCTION TO BIDDERS:

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

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

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and

performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories 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 unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard 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 under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 STANDARDS

3.3.1 The Contractor is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956, and other local rules and regulations.

3.3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The Contractor shall also note that list of standards presented in this specified is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3.3 Other internationally accepted standards which ensure equivalent or better performance that that specified in the standards referred under section shall also be acceptable.

3.3.4 In case governing standards for the equipment is different from IS or IEC,the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard of relevant extract of the same. The

equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

3.3.5 The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS British Standards
IEC/CISPR International Electro-technical Commission
IS Bureau of Indian Standards
ISO International Organisation for Standards
NEMA National Electric Manufacturers Association

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. 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, (not applicable for this project) short circuit etc for the equipment.

The equipment shall also comply with the following:

a) All equipments shall be suitable for hot line washing.
b). To facilitate erection of equipment, all items to be assembled at site shall be "match marked"".
c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.
d) All equipment shall be supplied with necessary interpole cabling, and its cost shall be included in the cost of equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

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

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

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

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

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data,reports, information, etc. shall be followed by Contractor:

a. All data/information furnished by Vendor in the form of drawings, documents, catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shal l be as mutually agreed between Contractor and Employer.

c. All drawings (including those of subvendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The format of title block shall approved by Engineer within thirty (30) days after the letter of award. The Contractor shall give this format to his subvendor along with his purchase order for subvendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.

d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

f. Contractor shall resubmit the drawings approved under Category II and III within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)

g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (alongwith reasons for changes) for Employer's review and approval.

i. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

j. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

3.5.3 Erection Drawings.

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least thirty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment alongwith log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporated and the updated final instruction manuals shall be submitted .

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedure to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer" standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

3.5.5 Final Submission of drawings and documents:

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

a. List of drawings bearing the Employer's and Contractor's drawing number.
b. Ten (10) bound sets alongwith 4 CD-ROMs of all drawing.
c. All documents/designs in five (5) copies as noted above.
d. Contractor shall also furnish nine (9) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish four (4) sets of film reproducibles or CD-ROMs of all as-built drawings as decided by the Employer.
e. The Contractor shall also furnish eleven (11) copies of instruction manuals (after approval) for all the equipments.

3.5.6 TEST REPORTS

Five (5) copies of all test reports shall be supplied for approval before shipment of equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

3.6 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential 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 and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 LIMIT OF CONTRACT

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not

covered specifically but which are found to be required for fulfillment of the scope of work under specification.

3.8 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 favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

SPACE HEATERS

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

Degree of Protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

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

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

3.9 RATING PLATES, NAME PLATES AND LABELS

3.9.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.

3.9.2 The rated current, extended current rating and rated thermal current shall be cl early indicated in the name plate in case of current transformer.

3.9.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.

3.9.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicoid.

3.9.5 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

3.10 GALVANISING :

3.10.1 The galvanised surface shall consist of a continuous film adhering to the st eel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.

3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acidspots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness ofzinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.

3.10.3 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads

having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

3.11 PAINTING

The sheet steel to be painted shall be pretreated in tanks in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic paining shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

3.12 QUALITY ASSURANCE PROGRAMME

3.12.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

i. His organisation structure for the management and implementation of the proposed quality assurance programme
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.
vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
ix. Inspection and test procedure both for manufacture and field activities.
x. Control of calibration and testing of measuring testing equipments.
xi. System for Quality Audits.
xii. System for identification and appraisal of inspection status.
xiii. System for authorising release of manufactured product to the Employer.

xiv. System for handling storage and delivery.
xv. System for maintenance of records, and
xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

3.12.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.12.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification.
This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

3.12.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor"s/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

3.12.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.

3.12.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans alongwith Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer alongwith technical justification for approval and dispositioning.

3.12.2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.

3.12.2.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, ch emical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

3.12.2.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

3.12.2.8 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

3.12.2.9 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

3.12.2.10 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with.

3.12.2.11 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

3.12.2.12 No welding shall be carried out on cast iron components for repair.

3.12.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

3.12.2.14 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personn el employed and details of co-relation of the test report with the job.

3.12.2.15 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's

purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc..

Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor.

3.12.2.16 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their subvendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

3.12.2.17 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

3.12.2.18 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

3.12.2.19 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

3.12.2.20 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.12.2.21 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

a. All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from Manufacturing works, as per the following cycle.

b. Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

c. Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor alongwith the statistical figures to validate the alternate procedure to be forwarded.

The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.12.3 QUALITY ASSURANCE DOCUMENTS

3.12.3.1 The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identifed in respective quality plan with tick (_) mark within three weeks after despatch of the equipment. Typical contents of Quality Assurance Document is as below:-

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
iv) Type test report(wherever applicable).
v) Non-destructive examination results /reports including radiography interpretation reports.
Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
vi) Heat Treatment Certificate/Record (Time- temperature Chart)
vii) All the accepted Non-conformance Reports (Major/Minor) / deviation,

including complete technical details / repair procedure)Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily

viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

ix) Certificate of Conformance (COC) whever applicable.

x) MDCC

3.12.3.2 Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents (in line with above) pertaining to field activities as per Approved Field Quality Plans and otheragreed manuals/ procedures, prior to commissioning of individual system.

3.12.3.3 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector.
The Quality Document file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.Each quality document shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

3.12.3.4 Before shipping any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory.The Inspector shall stamp,the quality document (or applicable section) for release.

ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents (or finalization of the applicable section of the quality document within one month as per corresponding shipment date).The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status (signed by the Supplier Representative) to the Inspector and notify of the committed date for the completion of all outstanding actions & submission.The Inspector shall stamp the quality document for applicable section when it is effectively completed.
The final quality document will be compiled and issued at the final assembly place of equipment before shipment.

3.12.4 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment . One set of quality document shall be forwarded to

Corporate Quality Assurance Department and other set to respective Site .
For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above

3.13 TYPE TESTING , INSPECTION, TESTING & INSPECTION CERTIFICATE

3.13.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

3.13.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

3.13.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

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

3.13.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works.The completion of these tests, or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

3.13.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

3.13.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

3.13.8 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 3.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

3.13.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, thecontractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

3.14 PACKAGING & PROTECTION

3.14.1 Packing, Marking and shipping

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

a. The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.

b. The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.

c. The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.

d. The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.

e. Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.

f. The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.14.2 Transportation

a. The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.

b. All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted

to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor

3.14.3 Insurance

a. The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

b. Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute groups for claims for extension in time or for extra payment.

3.14.4 Storage of Equipment

a. The Contractor shall provide and construct adequate storage sheds for proper storage of equipment. Sensitive equipments shall be stored indoors. All equipment during storage shall be protected against damage due to act of nature or accidents. The storage instructions of the equipment manufacturers shall be strictly adhered to.

b. The necessary transport packing shall be removed as soon as possible after receipt of equipment at the work site(s).

3.15 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.15.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

3.15.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

3.15.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

3.15.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

3.15.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

3.15.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

3.15.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till

erection time.

3.16 CONTROL CABINETS , JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT .

3.16.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.

3.16.2 They shall be of painted sheet steel or aluminium. The thickness of sheet steel shall be 2mm cold rolled or 2.5mm hot rolled. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. The paint shall be of grey RAL 9002 on the outside and glossy white inside. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness.

3.16.3 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.

3.16.4 The degree of protection of of all the outdoor boxes shall not be less than IP 55 as per IS 2147.

3.16.5 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.

3.16.6 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.

3.16.7 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.

3.16.8 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background

3.17 TERMINAL BLOCKS

3.17.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.

3.17.2 The terminal blocks shall be of 1100 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.

3.17.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating
plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.

3.17.4 The terminals shall be provided with marking tags for wiring identification.

3.17.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:
All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor
AC & DC power supply -Two 16 sq.mm. aluminium conductor
Circuits
Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor
3.18.02 The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

3.18 Wiring

3.18.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:
a) All circuits except CT circuits 2.5 sq.mm
b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).

3.18.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

3.18.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

3.18.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.

3.18.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.

3.19 CABLE GLANDS AND LUGS

3.19.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust

and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

3.19.2 The cable glands shall be tested as per BS:6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

3.19.3 Cables lugs shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.20 CONDUITS, PIPES AND ACCESSORIES

3.20.1 The Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.20.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

3.20.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.21 MOTOR CONTROL CENTRE

3.21.1 The 415 Volt motor control centres (if provided separately) shall conform to the requirements for boxes/cabinets/kiosks. They shall be fixed type, shall be fully sectionalised and shall be equipped with load break switches. Motor feeders shall be provided with isolating switch fuse unit and Contractor with thermal overload relay and single phase protection. The motor Contractor shall have one normally open auxiliary contact for alarm purposes. The motor control circuit shall be independent from all other control circuits.

3.21.2 Isolating Switches

The incoming power supply isolating switch operation handle shall be interlocked with the control cabinet door as to prevent opening of door when main switch is closed. Device for by passing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

3.21.3 Fuses

All fuses shall be of the HRC cartridge type, conforming to IS:2208 and suitable to mount on plugin type of fuse bases. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded, and it shall be possible to change fuses with the circuit alive, without danger of contact with live conductor. Insulated fuse pulling handle shall be

supplied with each control cabinet.

3.22 MOTORS

3.23.01 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 conform to type tests and shall be subjected to routine tests as per applicable standards.

3.23.02 Enclosures

a) For motors to be installed outdoor, the motor enclosure shall have degree of protection IP:55. For motors to be installed indoor, i.e. inside a box, the motor enclosure shall be dust proof equivalent to IP:44.
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 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 or facility for lifting.

3.23.03 Operational Features :

a) Continuous motor ratings (name plate rating) shall be at least suitable for the driven equipment at design duty operating point of driven equipment that will arise in service.
b) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the given system.

3.23.04 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.
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 given in IS:325.
d) Motors when started with driven equipment imposing full staring torque and 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 a least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Contractor shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated. The speed switch shall be capable of withstanding 120% of the rated speed in either directions of rotation.

3.23.05 The maximum permissible temperature rise over the ambient temperature shall be

within the limits specified in IS:325 (for 3 phase induction motors) after adjustment due to increased ambient temperature specified.

3.23.06 The double amplitude of motor vibration shall be within the limits specified in IS:729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

3.23.07 All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes.

3.23 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.24 LAMPS AND SOCKETS

3.25.1 Lamps:

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

3.25.2 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.

3.25.3 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.

3.25.4 Switches and Fuses:

Each control 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 switch-fuse units. Selection of the main and sub-circuit 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 of the fuse rating and voltage.

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

3.25 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

3.25.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC:137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS:2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.
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.

3.25.2 Porcelain used shall be homogenous, 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. Hollow porcelain should be in one integral piece in green & fired stage.

3.25.3 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.25.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.

3.25.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.25.6 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

3.25.7 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.25.8 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, 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.

3.25.9 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; 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.

3.25.10 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.

3.25.11 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

3.26 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

The corona (for 400kV only) and RIV tests shall confirm to the requirements as per **Annexure A** to this chapter. The seismic withstand test for 400kV shall conform to requirements as per **Annexure B** to this chapter.

3.27 Enclosures:

1. Annexure- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. Annexure- B - SEISMIC WITHSTAND TEST

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 both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage (RIV).

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 – I. 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 result 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 measurement 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%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendations 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 the voltage read by the noise meter.
4.0	**Test Methods for visible Corona** The purpose of this test is to determine the corona extinction voltage of the 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 130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test 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 the 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%,115% and 130%.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 procedure 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 connectors so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that test object essentially fills the frame with no cut off.
4.1	For recording purposes, modern devices using UV recording methods such as image intensifier may also be used.
4.2	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.
4.3	In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of the test equipment and test object. Thes e 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.
4.4	The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
4.5	However both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification or treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of the owner's engineer, if in his opinion it will not prejudice other test.
5.0	**Test Records:**
	In addition to the information previously mentioned and requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in the test report-
a)	Background noise before and after the test
b)	Detailed procedure of application of test voltage
c)	Measurement of RIV levels expressed in microvolts 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 micro volt in each direction.
f)	Onset and extinction of visible corona for each of the four tests required shall be recorded.

Annexure – B

SEISMIC WITHSTAND TEST
(For 400kV Only)

The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.

The bidder shall arrange to transport the structure from his contractor's premises / owner's sites for 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 at any other point as agreed by the owner. 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.

CLAUSE NO.	BIDDER'S NAME	
	E - 4 **EHV SURGE ARRESTERS**	
	SURGE ARRESTERS	
1.0	**GENERAL**	
	a) Name & country of the Manufacturer	.....
	b) Manufacturer's type designation	.....
	c) Applicable Standard	.....
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)	.....

CLAUSE NO.	BIDDER'S NAME	
	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 short duration (A peak)	.....
	l) Pressure relief class	.....
3.0	**EXTERNAL INSULATION**	
	a) One minute power frequency withstand voltage of arrester housing dry & wet (kV rms)	.....

CLAUSE NO.	BIDDER'S NAME	
	E - 13	
	EHV INSULATORS FOR CHAPTER E1 TO 6&12	
A.	**BUSHING / HOLLOW INSULATORS**	
	(Bidder shall furnish these data for each equipment separately i.e . for circuit Breakers, Instrument Transformer, Surge Arrestors, etc.)	
	1. Manufacturer's Name	.....
	2. Country of Manufacturer	.....
	3. Type	.....
	4. Applicable Standards	.....
	5. i) Height	.....
	ii) Diameter (Top)	.....
	iii) Diameter (Bottom)	.....
	6. Creepage distance	.....
	a) Total (mm)	.....
	7. Rated Voltage	.....
	8. Power frequency withstand voltage for 1 min. (kv rms)	.....
	i) Dry	.....
	ii) Wet	.....
	9. 1.2/50 micro sec. impulse withstand voltage (kVp)	.....
	10. 250/2500 Micro sec. switching impulse withstand voltage (kVp)	.....
	i) Dry	.....
	ii) Wet	.....

CLAUSE NO.	BIDDER'S NAME	
	11. Weight (Kg)	.....
	12. Cantilever Strength (Kg)	.....
	13. OGA drawing enclosed	Yes/No
B.	**BUS POST INSULATOR**	
	(Bidder shall furnish these data for solid core Insulators for Disconnecting switches, bus support, etc. separately)	
	1. Manufacturer's Name	.....
	2. Country of Manufacturer	.....
	3. Type of Insulator (Product No.)	.....
	4. Applicable Standards	.....
	5. No. of units per Stack	.....
	6. Diameter & No. of Bolts	.....
	ii) Top	.....
	ii) Bottom	.....
	7. Bolt circle diameter (mm)	.....
	ii) Top	.....
	iii) Bottom	.....
	8. Height of complete stack (mm)	.....
	9. Total Creepage distance (mm)	.....
	10. Power frequency withstand voltage of insulator with corona ring	.....
	i) Dry (kV rms)	.....
	ii) Wet (kV rms)	.....

SECTION - 5

QUALITY PLAN

Supplier shall follow valid approved Quality Plan of NTPC.

-X-

SECTION – 6

Check List

1. TECHNICAL REQUIREMENTS (FOR SURGE ARRESTER)

S. No.	PARTICULARS	Unit	390 kV		120 kV		33 kV	
1.	Designation	-	Heavy duty, Station class					
2.	Application	-	Surge protection of transformer/ line / bus bar					
3.	Type	-	Metal Oxide, Gapless					YES/ NO
4.	Installation	-	Outdoor					
	Rated System voltage	kV	420	YES/NO	145	YES/NO	33	YES/ NO
5.	Arrester Rated Voltage	ϛκ	390	YES/NO	120	YES/NO	30	YES/ NO
6.	Max. Cont. Operating Voltage (MCOV) at 50°C	kV	303	YES/NO	102	YES/NO	24	YES/ NO
7.	Rated Frequency	Hz	50					YES/ NO
8.	Rated nominal discharge current for 8/20 µs wave	kA	10					YES/ NO
9.	Minimum discharge capability *Section 2-clause 5.02.00 (m)	kJ/kV	**8***	YES/NO	5	YES/NO	5	YES/ NO
10.	Min. switching residual voltage (1 kA)	kVp	730	YES/NO	-	YES/NO	-	YES/ NO
11.	Max. switching residual voltage (1 kA)	kVp	780	YES/NO	280	YES/NO	70	YES/ NO
12.	Max. Residual Voltage for 8/20 µs at:							YES/ NO
	a) 5 kA	kVp	-	YES/NO	310	YES/NO		YES/ NO
	b) 10 kA	kVp	900	YES/NO	330	YES/NO	85	YES/ NO
	c) 20 kA	kVp	975	YES/NO	-	YES/NO		YES/ NO
13.	One minute dry/ wet power frequency withstand test voltage for arrester housing	kV_{rms}	630	YES/NO	275	YES/NO	70	YES/ NO
14.	Impulse withstand Voltage of arrester housing (1.2/50 ms wave) Dry and wet	kV_p	±1425	YES/NO	±650	YES/NO	170	YES/ NO
15.	Long duration discharge class		3	YES/NO	3	YES/NO	3	YES/ NO
16.	Current for pressure relief test	kA_{rms}	50	YES/NO	40	YES/NO	25	YES/ NO

17.	Min. total creepage distance	mm	**10500**	YES/NO	**3625**	YES/NO	**900**	YES/ NO
18.	Switching impulse withstand Voltage of arrester housing (1.2/50 μs wave) Dry and wet	kV_p	±1050	YES/NO	NA	YES/NO		YES/ NO
19.	Prospective symmetrical fault current for 1 sec	kA	50	YES/NO	40	YES/NO	25	YES/ NO
20.	Pressure relief class		Class A of table VII of IS 3070 or equivalent IEC					YES/ NO
21.	RIV at specified power frequency voltage	μV	Less than 1000 at 266 kV_{rms}	YES/NO	Less than 1000 at 92kV $_{rms}$	YES/NO		YES/ NO
22.	Partial discharge at 1.05 MCOV	pC			Not more than 50	YES/NO		
23.	Life Expectancy		100 years under site conditions considering effects of direct solar radiation					YES/ NO
24.	Suitability to Hot Line Washing							YES
25.	Items to be supplied as per sub-supplier list given in section 1			YES		YES		YES
26.	Surge arresters shall be capable of protecting the equipment as given in section 2.			YES		YES		YES
27.	Parts/ Accessories to be supplied with SA as mentioned below but not limited to it.			YES		YES		YES
i)	Surge Counter			YES		YES		YES
ii)	Insulating base			YES		YES		YES
iii)	Corona ring (if applicable)			YES		YES		YES
iv)	Terminal clamp suitable for Twin Moose ACSR conductor			YES		YES		YES
v)	Hardware required for inter-unit connection and to connect the surge arrester to structure			YES		YES		YES
vi)	Insulated interconnecting cable between arrester and surge monitor. (cables for all SA at a station supplied in single length)		4m for each SA	YES	3 m for each SA	YES	3 m for each SA	YES

2. TYPE TESTS

Whether Type test reports of the tests conducted earlier (not more than ten 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 then the following tests shall be conducted by the bidder free of cost. **YES/NO**

3. TYPE TESTS FOR SURGE ARRESTER

Sl. No.	TESTS	REPORT NO.	YES/NO
A	**Type tests**		
1.	Voltage withstand test for arrestor insulation		
2.	Power frequency voltage sparkover test		
3.	Standard lightning voltage impulse sparkover test		
4.	Lightning-voltage impulse sparkover voltage test		
5.	Switching-voltage impulse sparkover voltage/ time curve test		
6.	Residual voltage test		
7.	Current impulse withstand tests		
8.	Operating duty test		
9.	Galvanization test on metal parts		
10.	Pressure relief test		
11.	Tests of arrester disconnectors when fitted		
12.	Temperature cycle test on porcelain housing		
13.	Porosity test on porcelain components		
14.	Visual examination of porcelain housing		