



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-401-510-E29	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	PC	RD/VK	AG
TITLE Telecommunication Equipment				SIGN			3122011
				DATE			
				GROUP			
CUSTOMER	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD. (UPRVUNL)						
CONSULTANT	1. NTPC (Review consultant) 2. DCPL						
PROJECT	400kV Switchyard for Panki Thermal Power Station (1X660MW) Project code : 401						

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NOTE-Offers submitted without checklist (Section-4) shall not be evaluated		

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
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				Copies	2	-	-	-

SECTION -I

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of Survey, planning, design, manufacture, testing at works, packing, dispatch, supervision of erection and site testing and commissioning of the Telecommunication equipments/items, complete in all respect for 400kV Panki substation and its remote end. The detailed technical specification is enclosed under Section II of this specification.

Bidder is responsible for the designing, engineering, testing and supply including transportation & insurance, at site of mandatory spares and testing instruments for telecommunication equipments.

This section covers the specific technical requirements of Telecommunication Equipment System. This constitutes minimum technical parameters for the telecommunication system as specified by the customer (UPRVUNL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under Section-III of this specification.

The specification comprise of following sections:

- | | |
|--------------|---|
| Section-I: | Scope, Specific Technical Requirements & Bill of Quantities |
| Section-II: | Detailed Technical Requirement - Equipment Specification |
| Section-III: | Project Details & General Technical Requirements |
| Section-IV: | Enclosures to Specifications |

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

Note: The terms used in this specification namely, "Employer/Purchaser" refers to UPRVUNL, "Contractor" refers to BHEL & "Sub-contractor" refers to successful bidder.

1.1 The equipment is required for the following Project.

Name of Customer : Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd (TE)

Name of the Project: 400kV Switchyard for Panki Thermal Power Station (1x660MW)

Name of Consultants: NTPC (Review Consultant)
DCPL, Kolkata

Refer Section - III for Project Details and General Specifications.

1.2 SCOPE:

1.2.1 The broad Scope of the procurement of Communication Equipment shall include planning, designing, engineering, supply, transportation, insurance, delivery at site, supervision of installation, termination, testing, training and demonstration for acceptance, commissioning and documentation for:

- i) SDH Equipment along with suitable interfaces and line cards.
- ii) All cabling, wiring, Digital Distribution frame patch facilities and interconnection to the supplied equipment at the defined interfaces.
- iii) System integration of all supplied subsystem.
- iv) Integration of supplied subsystem with SCADA system, PABX of RLDC/NLDC, VOIP (SIP compliant) for voice.
- v) Offered differential protection interfaces (according to IEEE C37.94 standard) shall be suitable for 4nos. line differential protection relays at each end.

1.2.2 Customer specific specification is attached as Annexure-I to the Section-I

1.3 TECHNICAL REQUIREMENTS

The SDH equipment shall be offered from a manufacturer(s) who has been manufacturing SDH equipment for the last three (3) years and SDH equipment manufactured by such manufacturer (s) shall have been in satisfactory operation in 110kV or higher voltage power substations for the last (2) years as on the date of opening of Bids.

Satisfactory operation means certificate issued by the Employer/ Utility certifying the operation without any adverse remark.

Please note: Forms of undertaking if any (as per customer/BHEL format) shall be furnished to successful bidder during contract stage.

1.4 BILL OF QUANTITY

Fibre Optic Telecommunication equipment for 1x660MW Panki TPP substation.

The BOQ mentioned below is tentative and is liable to change based on the link budget calculations submitted by bidder during detail engineering.

SN	DESCRIPTION	UNIT	SITE-1	SITE-2	TOTAL QTY
1.	Transmission Equipment : SDH Equipment (STM-4 equipped with up to 3 MSP protected directions) + PDH Equipment:- Base Equipment (Common cards, Redundant Power Supply, Cross-connect/control cards, internal power cabling, other hardware & accessories including sub-racks patch cords, DDF etc. fully equipped (SDH and PDH may be integrated or separate)	No.	1	1	2
2.	Optical Interface card/SFP for Short Haul	No.	2	2	4
3.	Tributary Cards : E1 Interface card (Minimum 16 interfaces per card)	No.	2	2	4
4.	Tributary Cards : Ethernet interface 10/100 Mbps with layer-2 switching (Minimum 4 interfaces per card)	No.	2	2	4
5.	Subscriber Line Interface card : 2 wire (sub/sub) voice channel cards (min 8 channels per card)	No.	--	2	2
6.	Subscriber Line Interface card: 2 wire (sub/Exch) voice channel cards (min 8 channels per card)	No.	2	--	2
7.	Subscriber Line Interface card: 4 wire (E & M) voice channel cards (min 8 channels per card)	No.	1	1	2
8.	Integrated Differential Protection Module (4port) for differential protection application suitable according to IEEE C37.94 standard along with optical termination cable	No.	2	2	4
9.	Pre-connectorized Optical Fiber Patch Cord (each of 30 mtr length) with suitable connectors at both ends (for both local & remote end differential relay interfacing)	Lot	1		1
10.	Network Manager & Element Manager System(NMS):- Hardware::Server -2.33Ghz, 2 GB DDR, 80 GB SAS HDD, Integrated Gigabit Ethernet network interface, 15" TFT screen or equivalent	Set	1	--	1
11.	Network Manager & Element Manager System(NMS):- Hardware::Local operator console/workstation, 2.4 Ghz, 4GB RAM, 80GB, SATA HDD or equivalent	Set	1	--	1

UPRVUNL 400kV Switchyard for Panki Thermal Power Station (1x660MW)

Bharat Heavy Electricals Ltd

Telecommunication Equipment

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12.	Network Manager & Element Manager System(NMS):- Software::Server	Set	1	--	1
13.	Network Manager & Element Manager System(NMS):- Software:: Local operator console/ workstation	Set	1	--	1
14.	Craft Terminal:- Hardware:: 2.33Ghz, 2 GB DDR, 80 GB SAS HDD, Integrated Gigabit Ethernet network interface, 15"TFT screen or equivalent	Set	1	--	1
15.	Craft Terminal:-Software	Set	1	--	1
16.	Printer:: (LaserJet) A3/A4	No.	1	--	1
17.	Equipment Cabinet	Set	1	1	2
18.	EPAX (24/8) with 24Nos telephones, cables etc	Set	1	--	1
19.	5 Pair Telephone Cables, armored, 0.5 sq. mm annealed copper conductor and petroleum jelly filled with polyethene outer jackets	kms	0.2	--	0.2
20.	Single Pair Telephone Cable	kms	1	--	1
21.	VOIP telephone instrument with one common switch (minimum 8 ports)	No.	2	2	4
22.	Main Distribution Frame (50pairs)	No.	1	1	2
23.	FODP: Indoor Type Rack mounted FCPC Coupling & Pigtails suitable for 48 Fibers	No.	1	1	2
24.	Fiber Optic Approach Cable (Armoured,24F) with HDPE pipe 40mm dia	kms	2		2
25.	Mandatory Spare : Optical Interface card/SFP for Short Haul	No.	2	--	2
26.	Mandatory Spare : Optical Interface card/SFP for Long Haul L4.2	No.	2	--	2
27.	Services: Splicing of fibers	Lot	1		1
28.	Services : SAT & commissioning of communication system including supervision of installation	Lot	1		1

#

Optical Interface/SFP can be provided with optical base card or control card with the condition that control card shall not be equipped with more than one Optical interface / SFP and optical card with not more than two optical interface /SFP . However main and protection channel shall be terminated on separate cards.

****** Suitable optical interface card(s) or any other solution such as SDH equipment with optical amplifier, wavelength translator or higher aggregate bit rate SDH equipment may be offered to meet the link budget requirements without repeater

NOTE-

- Qty variation shall be +/- 50%.Some line items may be deleted/added.
- Software, Hardware (Viz. Optical Patch cable, Signal cable, wiring, connectors, expansion chassis etc) required for installation of above cards is deemed to be included in the scope.
- Required quantity of Panels/ Cabinets for housing OLTE/ PDH/ FODP etc. are deemed to be included in the offered price as per customer approved drawings. No price implication shall be entertained during execution and handing-over of the system.
- Splicing of Fibres 1 Lot = Splicing as required at FODP, OPGW Joint Box etc. for both local and remote ends for successful commissioning of the system shall be included in the offered price.
- Fibre Distribution Panel shall be Stand-alone type/ Panel-mounted as per customer approved drawing. No price implication shall be entertained during contract stage regarding the same.
- Successful commissioning of all the Communication Links with the Remote end stations shall

be in bidder's scope for this tender. Necessary co-ordination, modification and interfacing with remote end existing equipments as applicable shall be in bidder's scope.

- SAT & Commissioning of Tele-Communication System including Supervision of Installation - -- 1 Lot covers both local and remote ends for successful commissioning of the links under present scope.
- All SFP's shall be mounted in the SDH cabinets being offered.

1.5 APPROVAL CRITERION:

- a) The contract drawings shall preferably be UPRVUNL standard approved drawings or shall be approved by UPRVUNL in some of their previous project. The approval extension of standard drawings for this project or obtaining fresh approval from UPRVUNL Engg shall be the sole responsibility of the bidder without any price and delivery implications to BHEL.
- b) The items offered shall be of approved make and model from UPRVUNL and is working satisfactorily in their projects.
- c) In case, the offered item is not UPRVUNL approved then it is the sole responsibility of the bidder to get it approved without any price & Delivery implication to BHEL.

1.6 TYPE TEST REQUIREMENTS:

The reports for all type tests as per technical specification shall be furnished by the Bidder along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in UPRVUNL shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPRVUNL or representative authorized by UPRVUNL or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 05 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 05 (five) years prior to the date of bid opening, the bidder shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser. In case type tests are required to be conducted / repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the contractor.

1.7 QUALITY PLAN

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

1.8 PACKING:

- a. All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 2 years) at site till the time of erection. While packing all the materials, the limitations from the point of view

- of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- b. The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.
 - c. All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.
 - d. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
 - e. Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
 - f. Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
 - g. All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
 - h. Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
 - i. Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

1.9 DEVIATION:

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

1.10 DOCUMENTATION:

Final Documentation (after approval) shall be separate for each Substation. List of documents to be submitted is mentioned in section-2 of specification.

1.11 DOCUMENTS REQUIRED DURING TENDER STAGE:

Following documents are required during tender stage:

- a) Clause wise compliance to the specification
- b) Available catalogs of offered items
- c) Un-priced Bill of Quantity
- d) Documents in support of PQR

Annexure to Section-1

To establish communication between Panki TPP and 400 KV Panki where where fiber optic communication node is available, two nos Fiber Optic Transmission Equipment will be required , one equipment at each site. The brief specification of SDH STM-4 along with PDH Interface (Primary Multiplexer) is furnished below.

Fiber Optic SDH STM-4 Multiplex Equipment

1. Design Criteria

The following criteria shall be followed with respect to two nodes while designing SDH STM-4 FO system.

a) Multiplexer Nodes

1. The new MUX shall support hybrid switching network technology which are:

- Circuit-Switching TDM for SDH STM-4 level and upgradable to STM-16
- Packet-Switching for TCP/IP applications

2. Each Node shall support the following interfaces:

- Optical Interfaces STM-4 (Outbound link)
- V.24 RS232 Serial interfaces (for IEC 60870-101 SCADA links)
- TCP/IP Switching & VLAN functions (for IEC 60870-104, IT, Energy Metering, VoIP phones).
- 8 x 10/100/1000 BaseTPoE Interface
- IEEE C37.94 optical interfaces 850nm MM (For Tele-protection)
- I/O Teleprotectionintertripping units (For Tele-protection)
- Redundant Central Processor CPU and Power Supply PSU units

3. Contractor shall provide Network Management System with necessary software and hardware.

2. General Requirements

- a) The SDH system shall be designed for digital transmission using single mode optical fibres and shall conform to the ITU-T recommendations G.703, G.704, G.707, G.783 and G.957.
- b) The multiplexing structure of the proposed SDH system shall allow PDH signals to be carried over the synchronous network and shall permit the extraction of individual channels from high capacity systems without having to demultiplex the whole system.
- c) The SDH system shall be provided with direct software control of network functions and in-service provision, and comprehensive network management and distributed

bandwidth on demand facilities. In addition, remote test control and centralised alarm gathering and reporting features shall also be provided.

- d) A redundant configuration for ensuring minimum down time in case of equipment failure shall be provided. Any failure shall produce automatic switch-over to the back-up unit and initiation of an alarm

3. SDH Equipment

- a) The SDH equipment shall perform both multiplexing and optical line terminating functions. The aggregate ports of the SDH equipment shall be duplicated and shall be capable of operating in a '1 + 1' protected mode as part of a point to point link, or as an 'east/west' mode when used in a drop and insert chain in a ring. All features and functions of the SDH equipment shall be readily software configurable to suit operational requirements of the SDH system.

- b) The SDH equipment shall be capable of being configured as a hub, cross connection, repeater, add/drop multiplexer or terminal multiplexer.

- c) The SDH equipment shall be equipped with a range of plug-in tributary interfaces to support a comprehensive range of plesiochronous and synchronous tributaries including 2 Mb/s, 34 Mb/s and from STM-4 operation. Cross connection levels shall include 64 kb/s, VC-12, VC-3 and VC-4. The following interface card/modules shall be equipped in each of the SDH STM-4 equipment.

- Optical Interfaces STM4 (Outbound link) Redundant mode
- V.24 RS232 Serial interfaces (for IEC 60870-10) SCADA links)
- TCP/IP Switching & VLAN functions (for IEC 60870-104, IT, Energy Metering, Fault Recorder, Power Meter, Transformer Monitoring System, Relays Management, CCTV & VoIP phones).
- 8 x 10/100/1000 BaseTPoE Interface as minimum
- 2 wire FXS Interface-16 channel for site-1 only
- 2 wire FXO Interface-16 channel for site-2 only
- 4 wire E&M voice interface-8 channel-one card for Site-1 and one card for Site-2
- IEEE C37.94 optical interfaces and electrical (For Tele-protection)
- I/O Tele-protection intertripping units (For Tele-protection)
- Redundant Central Processor CPU and Power Supply PSU units

- d) SDH equipment shall be located on a fibre optic backbone system that serves the major facilities within the system.

- e) Details of the requirement of STM-4 with PDH interface shall be as per item sl no. 1,2,3 and 4 in Annexure-1.

4. Primary Access Multiplexing Equipment

- a) All primary access multiplexing, demultiplexing and signal processing and conditioning equipment shall be provided to interconnect SCADA, teleprotection and telecommunication equipment to the SDH system.
- b) Communication interfaces shall be capable of being made available by means of insertion of appropriate channel cards into the multiplexer rack. It is preferable that a channel card should contain all the components necessary to enable the same card to cater for as many different types of operation as possible by means of software configuration both locally and from a remote site. Details of the channel cards to be supplied by the Contractor shall be included in the Tender.

5. Network Management System

- a) The Network Management shall consist of one no. of Server, one no. workstation with keyboard and monitor and mouse . One no. work station with mouse, keyboard and monitor shall be used for operating software and configuration purpose. One no. craft terminal with CPU and monitor etc shall also be required. The NMS software shall carry out all configuration of the equipment and diagnostic check.
- b) Two no. of MDF-50 Pairs shall be required for two sites.
- c) Details of the requirement of Network Management System and MDF shall be as per item sl no. 5,6,7 and 8 in Annexure-I.

ANNEXURE-I : Specific Requirement

Fibre Optic Telecom Equipments for LX660 MWPanki TPP-Extn.

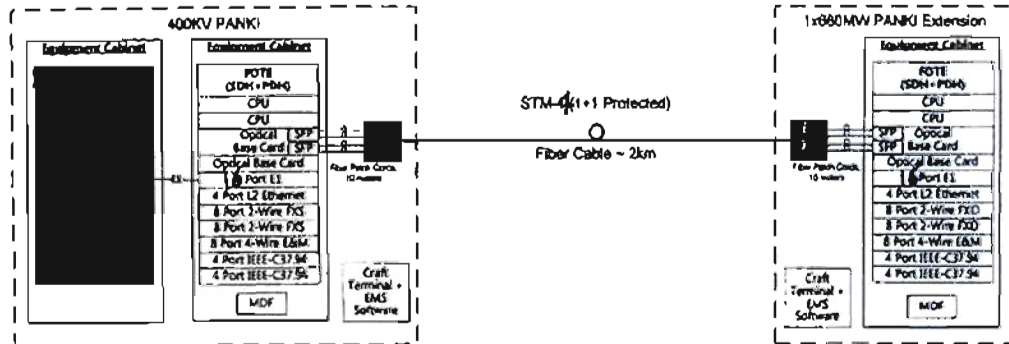
Sl. NO.	Transmission Equipments	Unit	Total Qty	Site -1	Site-2	Sapre for future extension
1	SDH Equipment-(STM-4, equipped with upto 3 MSP protected directons) + PDH Equipment					
(i)	Base equipment (Common cards,Redundant Power Supply and Cross connect cards,power cabling,other hardware & accessories including sub-racks,patch cords,DDF etc. fully equipped (SDH and PDH may be integrated or separate)	No.	2	1	1	
2	Optical Interface Cards/SFP#					
i.	Short Haul	No.	6	2	2	2
(ii)	Long Haul LX74.2		2			2
3	Tributary cards					
i	E1 Interface card (Minimum 16 Interfaces per card)	No.	4	2	2	
ii	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 Interfaces per card.)	No.	4	2	2	
4	Subscriber Line Interface Cards					
i.	2 Wire (sub/sub) voice channel cards (min 8 channels per card)	No.	2		2	
ii.	2 Wire (sub/Exch) voice channel cards (min 8 channels per card)	No.	2	2		
ii.	4 Wire (E&M) voice channel cards (min 8 channels per card)	No.	2	1	1	
	Integrated Differential Protection Module for differential protection application suitable according to IEEE C37.94 standard	No.	2	2		
5	Network Manager & Element Manager System(NMS)					
a.	Hardware-					
i.	Server- 2.33 2 GB DDR, 80 GB SAS HDD, INTEGRATED Gigabit Ethernet network interface, 15" TFT screen or equivalent	Set	1	1		

ANNEXURE-1: Specific Requirement

1L	Local operator console/ workstation, 2.4 Ghz, 4GB RAM, 80GB, SATA HDD or equivalent	Set	1	1		
b.	Software	Set	1	1		
i.	Server	Set	1	1		
1L	Local operator console/ workstation	Set	1	1		
5	Craft Terminal					
a.	Hardware-2.33 Ghz, 2GB DDR, 80Gb SAS HDD, Integrated 1gb/s Ethernet network interface, 15" TFT screen or equivalent	Set	1	1		
b.	Software	Set	1	1		
7	Printer (Laser J40)	No.	1	1		
8	Main Distribution Frame (50 pairs)	No.	2	1	1	

ANNEXURE-II : System Architecture

FIBER OPTIC COMMUNICATION EQUIPMENT 1 X 660 MW PANKI EXTENSION PROJECT



FOR TENDERING PURPOSE

Rev		Description		Date	
1	0	1	1	1	1
2	0	2	2	2	2
3	0	3	3	3	3
4	0	4	4	4	4
5	0	5	5	5	5
6	0	6	6	6	6
7	0	7	7	7	7
8	0	8	8	8	8
9	0	9	9	9	9
10	0	10	10	10	10
11	0	11	11	11	11
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37	0	37	37	37	37
38	0	38	38	38	38
39	0	39	39	39	39
40	0	40	40	40	40
41	0	41	41	41	41
42	0	42	42	42	42
43	0	43	43	43	43
44	0	44	44	44	44
45	0	45	45	45	45
46	0	46	46	46	46
47	0	47	47	47	47
48	0	48	48	48	48
49	0	49	49	49	49
50	0	50	50	50	50
51	0	51	51	51	51
52	0	52	52	52	52
53	0	53	53	53	53
54	0	54	54	54	54
55	0	55	55	55	55
56	0	56	56	56	56
57	0	57	57	57	57
58	0	58	58	58	58
59	0	59	59	59	59
60	0	60	60	60	60
61	0	61	61	61	61
62	0	62	62	62	62
63	0	63	63	63	63
64	0	64	64	64	64
65	0	65	65	65	65
66	0	66	66	66	66
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68	0	68	68	68	68
69	0	69	69	69	69
70	0	70	70	70	70
71	0	71	71	71	71
72	0	72	72	72	72
73	0	73	73	73	73
74	0	74	74	74	74
75	0	75	75	75	75
76	0	76	76	76	76
77	0	77	77	77	77
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80	0	80	80	80	80
81	0	81	81	81	81
82	0	82	82	82	82
83	0	83	83	83	83
84	0	84	84	84	84
85	0	85	85	85	85
86	0	86	86	86	86
87	0	87	87	87	87
88	0	88	88	88	88
89	0	89	89	89	89
90	0	90	90	90	90
91	0	91	91	91	91
92	0	92	92	92	92
93	0	93	93	93	93
94	0	94	94	94	94
95	0	95	95	95	95
96	0	96	96	96	96
97	0	97	97	97	97
98	0	98	98	98	98
99	0	99	99	99	99
100	0	100	100	100	100

Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. The actual mounting height and location shall be finalised after Survey. Contractor shall be responsible for splicing of fibres and installation of splice enclosures.

18.03.20 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful Contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

- (a) All fibre splices shall be accomplished through fusion splicing.
- (b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.
- (c) All splices and bare fibre shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.
- (d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.
- (e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

18.03.21 Fibre Optic Approach Cables

For purposes of this specification, a fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length requirements are indicated in the appendices. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly.

Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

Jacket Construction & Material

The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure



to ultra-violet light, weathering and high levels of pollution. The jacket shall conform to ASTM D1248 for density.

Optical, Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

Installation of Approach Cable

The approach cable shall be laid in the HDPE pipe in all condition.

Suitable provisions shall be made by the Contractor to ensure adequate safety earthing and insulated protection for the approach cable.

All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for laying and installation of approach cables shall be supplied and installed by the Contractor.

Optical Fibre Termination and Splicing

Optical fibre terminations shall be installed in Fibre Optic Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The Contractor shall provide rack /wall mounted Fibre Optic Distribution Panels (FODPs) sized as Indicated in the appendices and shall terminate the fibre optic cabling up to the FODPs. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

Fibre Optic Distribution Panel

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

- (a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings.
- (b) FODPs shall be suitable for use with each of the cable types provided as part of this contract.

FODPs shall accommodate pass-through splicing and fibre terminations.
- (c) FODPs for indoor use shall be supplied in suitable cabinets/racks with locking arrangement
- (d) All FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.



- (e) Flexible protection shall be provided to the patch cord bunches going out from FODP to other equipment.

Optical Fibre Connectors

Optical fibres shall be connectorised with FC-PC type connectors preferably. Alternatively connector with matching patch cord shall also be acceptable. Fibre optic couplings supplied with FODPs shall be appropriate for the fibre connectors to be supported.

18.03.22 Methodology for Installation and Termination

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the Owner for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. All installation practices shall be field proven and ISO accredited.

The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any fibre damage, the complete section (tension location to tension location) shall be replaced as mid-span joints are not acceptable.

19.00.00 TARIFF METERING

- 19.00.01 The net power generated by the proposed plant will be exported to UPPCL directly through 400 kV lines. Similarly, commissioning / start up power will be imported from UPPCL through 400KV/11kV Station Transformer.

- 19.00.02 For metering export/import of power, one main meter and one check meter and one standby meter will be provided for each of 400 kV lines and one at the 400KV side of the ST. Each of the main and check meters shall have the following features:

1. Microprocessor based
2. Measurement of import / export active energy, reactive energy and apparent
3. Energy. It shall also measure voltage, current, power factor, kW, kVAr, kVA etc
4. Accuracy of 0.2S
5. Facility for downloading the data

- 19.00.03 In addition to Tariff metering system, suitable energy meters of 0.2s class shall be provided at generator terminals to record generated gross energy. This meter shall also used for calculation of auxiliary power consumption.

- 19.00.04 Tariff metering and associated CTs & PTs shall comply with the requirements of CEA regulations on installation and operation of energy meters and shall also comply with the requirements of grid authorities.



SECTION - 2

EQUIPMENT SPECIFICATION

Ann - E5



CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Annexure I to Chapter 13				
	Network Configuration and Equipment Characteristics				
1.1	INTRODUCTION This section describes the Fiber Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are: (1) Fiber Optic Transmission System (FOTS) (2) DDF and Cabling (3) Craft Terminal based Network Management System (NMS) The requirements described herein are applicable to and in support of network requirements. The equipment supplied shall support existing regional network for Power system operational requirements. The security related requirements of the equipment shall be as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time to time basis shall be followed/complied by the vendor. The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing, facility and supply chain and subject all software to a security /threat check any time during the supplies of equipment The contractor shall ensure that the supplied equipment's have been got tested as per relevant contemporary Indian or International Security Standards e.g. IT and IT related elements against ISO/IEC 15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards until 31st March 2013. The certification shall be got done from authorized and certified agency/lab in India. The Contractor shall also ensure that the equipment supplied has all the contemporary security related features and features related to communication security as prescribed under relevant security standards. A list of features, equipment's, software etc. supplied and implemented in the project shall be given for use by the Employer The contractor shall get the Employer's equipment audited from security point of view once a year from a network audit and certification agency as identified by DoT. The audit of the equipment shall be carried once in a financial year till the maintenance service contract in the bid. In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of DoT and any other Government department.				
1.2	General Network Characteristics				
1.2.1	Description The fibre optic network shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-16. The network shall consist of overhead fibre optic links with a minimum bit rate of				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I(3X 800MW)</td> <td style="width: 33%; text-align: center;">TECHNICAL SPECIFICATIONS SECTION VI, PART B BID DOC NO.:CS.9585 001 2</td> <td style="width: 33%; text-align: center;">ANNEXURE -I TO SUB SECTION B-13 SUBSTATION AUTOMATION SYSTEM</td> <td style="width: 33%; text-align: center;">PAGE 1 OF 16</td> </tr> </table>		EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I(3X 800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART B BID DOC NO.:CS.9585 001 2	ANNEXURE -I TO SUB SECTION B-13 SUBSTATION AUTOMATION SYSTEM	PAGE 1 OF 16
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1.2.2	4 STM-4 Synchronous Transport Module 16 (STM-16). The Contractor can propose a system based on higher bit rate systems, if required, so as to meet the link budget requirements or any other specification requirement. The contractor shall develop numbering plan for the proposed voice communication system equipment. Functional Requirement The primary function of the communication network is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS, RTUs & PMUs and for new technological requirements of Power System Operation such as Special Protection Scheme, Grid Security Expert System, Load Management, Advanced Protection System & Substation Automation System. The communications support requirement for SCADA/EMS, RTUs, PMUs system & EPABX system is for low & high speed data, express voice circuits and administrative voice circuits as defined in appendices. A brief summary of the communication system requirements is as follows: (a) High speed E1 channel support (b) 64kbps & nx64kbps data channel support (c) Low speed (300 -1200 bps) data channel support (d) Voice (2 wires, 4 wires) channel support and integration with EPABX system. The details of EPABX System shall be provided during detailed engineering. (e) Data transport supporting Network Management channels (f) The connectivity envisaged between Substation and Control Centre over TCP-IP using Ethernet interface for various services of data and voice such as for PMUs, RTUs, VOIP. 1.2.3 General Systems Requirements Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level. 1.2.3.1 System Synchronization The Contractor shall synchronize the equipments under the contract using Master clock procured under the Substation Package. The contractor shall submit the synchronisation plan as per standard ITU-T G.811. All sync equipments proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-T G.812 standard requirements. The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipments new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-T G.803. The system equipment requiring "clock" shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.			
EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE -I(3X 800MW)	TECHNICAL SPECIFICATIONS SECTION VI, PART B BID DOC.NO: CS/9585/001/2	ANNEXURE -C TO SUB SECTION B-13 SUBSTATION AUTOMATION SYSTEM	PAGE 2 OF 16	

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1.2.3.2	System Maintainability To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed locally by Craft Terminal. Such testing shall not affect the functional operation of the system.			
1.2.3.3	System Upgradeability and Expandability Equipment supplied shall be sized (though not necessarily equipped) to support system/subsystem expansion to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies shall be sized for maximum equipped system capacity.			
1.2.3.4	Equipment Availability The calculated availability of each fibre optic link (E1 to E1) shall be at least 99.999%. The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. For this analysis, an MTTR of at least 4 hours shall be assumed. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided by the Contractor during detailed engineering.			
1.2.3.5	Revision Levels and Modifications All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most of current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by Employer, prior to the completion of SAT.			
1.2.3.6	Equipment Capacities Equipment supplied shall be sized and equipped with sufficient capacity and configuration to meet complete system requirement.. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion.			
1.2.3.7	Redundancy Requirements and Protection Schemes Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 2-1. The failure of one element shall not prevent the use of any other that has not failed.			
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1.2.3.11

Proposed Optical Fibre Characteristics

The link budget calculations and equipment design shall be based on the specified fibre parameters. The optical cables shall have Dual Window Single Mode (DWSM) fibres conforming to ITU-T Recommendations G.652D and the major parameters of these optical fibre(s) are defined in Table-2-2:

Table-2-2

Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode (DWSM)
Mode Field Diameter:	8.6 to 9.5 μ m ($\pm$ 0.6 μ m)
Cladding Diameter:	125.0 μ m + 1 μ m
Mode field Concentricity Error:	< 0.6 μ m

Table-2-2

Optical Fibre Characteristics

Core-Clad concentricity error:	< 1.0 μ m
Cladding non-circularity	< 1%
Cable Cut off Wavelength:	< 1260 nm
1550 loss performance	As per G.652D
Proof Test Level	– 0.69 Gpa
Attenuation coefficient	@1310nm < 0.35 dB/Km @1550nm < 0.21 dB/Km
Attenuation variation with wavelength 1285 nm - 1330 nm 1525 nm – 1575 nm	Attenuation coefficient @1310 $\pm$ 0.05 dB Attenuation coefficient @1550 $\pm$ 0.05 dB
Point discontinuities	< 0.1dB
Chromatic Dispersion; Max.:	18.0 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) @ 1288-1339nm 5.3 ps/(nm x km) @ 1271-1360nm
Zero Dispersion Wavelength:	1300 to 1324nm
Zero Dispersion Slope:	0.092 ps/(nm ² xkm) maximum
Polarization mode dispersion coefficient	< 0.2 ps/km ^{1/2}

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE –I(3X 800MW)

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CLAUSE NO.	TECHNICAL REQUIREMENTS							
	<table><tr><td>Temperature Dependence:</td><td>Induced attenuation < 0.05 dB (-60 deg C - +85 deg C)</td></tr><tr><td>Bend performance:</td><td>@1310nm (75+2 mm dia Mandrel), 100 turns; Attenuation rise _ 0.05 dB @1550nm (30+1 mm dia Mandrel), 100 turns; Attenuation rise _ 0.10 dB @1550nm (32+0.5 mm dia Mandrel), 1 turn; Attenuation rise _ 0.50 dB</td></tr></table>				Temperature Dependence:	Induced attenuation < 0.05 dB (-60 deg C - +85 deg C)	Bend performance:	@1310nm (75+2 mm dia Mandrel), 100 turns; Attenuation rise _ 0.05 dB @1550nm (30+1 mm dia Mandrel), 100 turns; Attenuation rise _ 0.10 dB @1550nm (32+0.5 mm dia Mandrel), 1 turn; Attenuation rise _ 0.50 dB
Temperature Dependence:	Induced attenuation < 0.05 dB (-60 deg C - +85 deg C)							
Bend performance:	@1310nm (75+2 mm dia Mandrel), 100 turns; Attenuation rise _ 0.05 dB @1550nm (30+1 mm dia Mandrel), 100 turns; Attenuation rise _ 0.10 dB @1550nm (32+0.5 mm dia Mandrel), 1 turn; Attenuation rise _ 0.50 dB							
1.2.4	Fibre Optic Link Lengths The exact cable lengths shall be provided during detailed engineering.							
1.3	Fibre Optic Transmission System The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4/STM-16 and equipped with minimum 16nos E1 interfaces (G.703) and minimum 4 nos. Ethernet interfaces (IEEE 802.3/IEEE 802.3u) supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. Protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032 The Contractor shall provide (supply and install) connectorised jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection. Two number spare jumpers shall be provided for each equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.							
1.3.1	SDH Equipment							
1.3.1.1	Functional Requirement For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary interfaces (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary interfaces). If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications. Further, main and protection channel shall be terminated on separate cards and there shall not be single point of failure.							
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1.3.2.1	Optical Source NOTE (2)	Laser		
	Optical Source Lifespan	Better than 5 X 10 ⁵ hours		
	Optical Fibre Type	G.652 D		
	Optical Connectors	Type FC-PC		
	Transmission Quality	Per ITU-T G.821, G.823, G.826		
	Source Primary Power	-48 Vdc		
	Equipment Specifications	Per ITU-T G.783		
	Tributary, Electrical Interface	Per ITU-T G.703, 750		
	Ethernet Interface	10/100 Mbps		
	SDH Bit Rates	Per ITU-T G.703		
	Optical Interfaces	Per ITU-T G.957, G.958		
	Frame and Multiplexing Structure for SDH	Per ITU-T G.707		
	Synchronization	Per ITU-T G.813		
	Management Functions	Per ITU-T G.774, G.784		
	Protection Architectures	Per ITU-T G.841		
	Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784		
	NOTE (1) Optical wavelength shall be finalised during detailed engg NOTE (2) Eye Safety for Laser Equipment: To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958. NOTE (3) In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector are to be provided to connect with FODP.			
	FODP to SDH Equipment			
	The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall provide FC PC coupled patch cords. The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.			
	EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE –I(3X 800MW)		TECHNICAL SPECIFICATIONS SECTION VI, PART B BID DOC.NO.:CS:9585 001 2	ANNEXURE –I TO SUB SECTION B 43 SUBSTATION AUTOMATION SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.4	DDF and Cabling For the purposes of the specification, the contractor shall provide cabling, wiring and DDF patching facilities to the wideband telecommunications system. Equipment and material components for DDF and cabling are also part of this procurement. It shall be the Contractor's responsibility to provide all cable support required for full supplied equipment interconnection and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.	
1.4.1	Digital Distribution Frame Functional Requirements The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband-quality (better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and Monitor Patch Jacks. DDFs shall provide the following basic functions: (i) "Normally thru" circuit routing (ii) Circuit rerouting via patch cord assemblies (iii) Circuit disconnect and termination All DDFs shall be sized and equipped to support the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.	
1.5	Patch Cords The Contractor has to supply FC PC coupled Patch cords. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.	
1.6	Craft terminal based /Telecommunication Management Network/Network Management System Each equipment on the fibre optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the operator shall be able to: a. Change the configuration of the station & the connected NEs. b. Perform tests c. Get detailed fault information The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with necessary system and application software to support the functions listed above, shall be supplied to the employer.	
1.6.1	Hardware Requirements - Craft Terminal Craft Terminal shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse etc., LAN port, serial/USB (2.0) ports to accommodate printers, and Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.	
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1.6.2	General Software/Firmware Requirements Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.	
1.6.3	Operating System Software Operating system software shall be provided to control the execution of system programs, application programs, and management devices, to allocate system resources, and manage communications among the system processors. The contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.	
1.6.4	Applications Software All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The contractor shall make no modifications to the applications program except as provided as USER development tools.	
1.6.5	Software Utilities A utility shall be provided to convert all reports into standard PC application formats such as excel.	
1.6.6	Revisions, Upgrades, Maintainability All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming. All software shall be easily user expandable to accommodate the anticipated system growth, as defined in this specification. Reassembly recompilation or revision upgrades of the software or components of the software, shall not be necessary to accommodate full system expansion.	
2.0	Software provided shall be compliant with national and international industry standards. List of Type Tests Test reports for following type tests shall be submitted. Reports / Certificates of tests conducted in accredited Laboratories (accredited by the national accrediting body of the country where the lab is located) are also acceptable.	
2.1	List of type test to be conducted on Telecom equipment The type tests for SDH Equipment with all types of cards are described below:	
2.1.1	Temperature and Humidity Tests The tests listed below are defined in IEC Publication 60068. (a) Low Temperature Test: Operation to Specifications	
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	Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications: (1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for sixteen (16) hours. Its performance is checked during the test. (2) Degree of Severity: Test shall be done at 0°C (3) Acceptance Criteria: No degradation of performance during and after the test. (b) Low Temperature Test : Operation without Damage Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications: (1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 72 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (<i>Post-test</i>). (2) Degree of Severity: Test shall be done at -10° C (3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the <i>post-test</i>. (c) Dry Heat Test: Operation to Specifications Dry heat test shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications: (1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test. (2) Degree of Severity: As per table 3-1: operation to specification range. (3) Acceptance Criteria: No degradation of performance during and after the test. (d) Dry Heat Test: Operation without Damage Dry heat tests shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications: (1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (<i>Post-test</i>). (2) Degree of Severity: Test shall be done at 55°C. (3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the <i>post-test</i>.		
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NTPC

(e) Damp Heat Test

Damp heat testing reveals aging with respect to the humidity level and applies basically to electronic equipment. This test shall be done as defined in IEC Publication 60068-2-78 with the following specifications:

- (1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 10 days. Its performance is checked during the test.
- (2) Degree of Severity: Test shall be done at $(40 \pm 2) ^\circ\text{C}$ & $(93 \pm 3) \% \text{ RH}$
- (2) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

(f) Temperature Variation Test

Temperature variation testing shall be as per IEC Publication 60068-2-14 (Gradual Variations, Method Nb). The equipment shall be powered on and various parameters shall be monitored continuously during the test period.

- (1) Number of cycles required is five (5)
- (2) The degree of severity: temperature TL: 0°C , TH: As per table 3-1 (Operation to specification range)
- (3) Cycle duration for each temperature is three (3) hours.
- (4) Ramp : $1 ^\circ\text{C/minute}$.
- (5) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

2.1.2

Power Supply and EMI/EMC tests

The test procedure and acceptance criteria shall be as defined in IEC 60870-2-1.

(a) Immunity Tests

The list of Immunity tests are specified below in Table 4-4:

Table 4-4: Recommended Immunity Tests

S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
1	Voltage Fluctuations	Yes	Yes	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 - Level : 1

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION
EXPANSION PHASE -I-(3X 800MW)

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CLAUSE NO.	TECHNICAL REQUIREMENTS					
2	Voltage dips and Interruptions	Yes	Yes	N/A	N/A	
3	1.2/50 - 8/20 μ s surges	Yes	Yes	Yes	N/A	Table 12 of IEC 60870-2-1: 1995 - Level : 4
4	Fast transient bursts	Yes	Yes	Yes	Yes	
5	Damped oscillatory waves	Yes	Yes	Yes	Yes	
6	10/700 μ s surges	N/A	N/A	N/A	Yes	
7	Electrostatic discharge	Yes				Table 13 of IEC 60870-2-1: 1995 - Level : 4
8	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - Level : 4
9	Damped oscillatory magnetic field	Yes				
Table 4-4: Recommended Immunity Tests						
S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control Signal	& Telecom Line	Para-metres
10	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 - Level : 4
11	Power Frequency voltage on control and signal lines	N/A	N/A	Yes	Yes	IEC 61000-4-16 : 2002-07 Level : 4
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CLAUSE NO	TECHNICAL REQUIREMENTS						
12	DC voltage on control and signal lines	N/A	N/A	Yes	N/A	IEC 61000-4-16 : 2002-07 Level : 4	
(b) Emission Tests							
The list of Emission tests are specified below in Table 4-5							
Table 4-5: Recommended Emission Tests							
S. NO.	Emission test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para- metres	
1	LF disturbance voltages CCITT recommendation P.53	N/A	Yes	N/A	N/A	Table 17 of IEC 60870-2-1: 1995 - Class : B	
2	RF disturbance voltages CISPR 22	Yes	Yes	N/A	N/A		
3	RF disturbance currents CISPR 22	N/A	N/A	N/A	Yes		
Table 4-5: Recommended Emission Tests							
S. NO.	Emission test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para- metres	
4	RF radiated fields CISPR 22	Yes					
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.1.3	(c) Insulation Withstand Voltages As per section 6 of IEC 870-2-1. Recommended class : VW1 of Table 18. Mechanical Tests (a) Mechanical Vibration Test The procedure for this test is described in IEC Publication 60068-2-6. The testing procedure shall be carried out in the sequence 8.1 + 8.2.1 + 8.1 as described in document 60068-2-6. For the vibration response investigation (clause 8.1 of 60068-2-6), the test shall be carried out over a sweep cycle under the same conditions as for the endurance test (described later), but the vibration amplitude and the sweep rate may be decreased below these conditions so that the determination of the response characteristics can be obtained. The endurance test conditions are selected according to the vibration withstand requirements. Transportation tests shall be performed with the equipment packed according to the Contractor's specifications. (b) Shock Test The procedure of this test is defined in IEC Publication 60068-2-27 (each test) with a semi-sinusoidal shape (clause 3.1.1.2). The recommended severity shall be $A = 294 \text{ m/s}^2$, $D = 18 \text{ ms}$. Three shocks per axis per direction shall be applied to the equipment packed according to the Contractor's specifications. Or Free Fall Test This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 60068-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 68-2-32. The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing. Or Bump Test This test could be performed as an alternative to Shock test or Free Fall test. The procedure is defined in IEC 60068-2-29. Hands-on training shall be provided to O&M personnel at site .		
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Optical Fibre & Approach Cable Parameters

1. Required Optical Fibre Characteristics

The optical fibre to be provided should have following characteristics :

1.1 Physical Characteristic

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 1-1(a) :

1.1.1 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 1-1 (a) shall be "guaranteed" fibre attenuation of any & every fibre reel.

Table 1-1(a)
DWSM Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter @ 1310nm:	8.6 to 9.5 μm ($\pm 0.6\mu\text{m}$)
Cladding Diameter:	125.0 $\mu\text{m} \pm 1 \mu\text{m}$
Mode field concentricity error	$\leq 0.6\mu\text{m}$
Cladding non-circularity	$\leq 1\%$
Cable Cut-off Wavelength λ_{cc}	$\leq 1260 \text{ nm}$
1550 nm loss performance	As per G.652 D
Proof Test Level	$\geq 0.69 \text{ Gpa}$
Attenuation Coefficient:	@ 1310 nm $\leq 0.35 \text{ dB / km}$ @ 1550 nm $\leq 0.21 \text{ dB / km}$
Chromatic Dispersion; Maximum:	18 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) 1288-1339nm 5.3 ps/(nm x km) 1271-1360nm 1300 to 1324nm 0.092 ps/(nm ² xkm) maximum
Zero Dispersion Wavelength:	
Zero Dispersion Slope:	
Polarization mode dispersion coefficient	$\leq 0.2 \text{ ps/km}^{1/2}$
Temperature Dependence:	Induced attenuation $\leq 0.05 \text{ dB}$ (-60°C to +85°C)
Bend Performance:	@ 1310 nm (75 $\pm$ 2 mm dia Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB/km}$ @ 1550 nm (75 $\pm$ 2 mm dia Mandrel), 100 turns; Attenuation Rise $\leq 0.10 \text{ dB/km}$ @ 1550 nm (32 $\pm$ 0.5 mm dia Mandrel), 1 turn; Attenuation Rise $\leq 0.50 \text{ dB/km}$

2 Fibre Optic Approach Cables

A fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building

2.1. Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

2.2 Jacket Construction & Material

The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall conform to ASTM D1248 for density.

2.3 Optical, Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

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SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

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

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

	Particular	Details
a)	Customer	Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd.
b)	Engineer Consultant	DCPL
c)	Engineer Review Consultant/ Inspector	NTPC Ltd.
d)	Project Title	Panki Thermal Power Project (3x660 MW): 400kV Switchyard
e)	Project Location	Place: Panki District: Kanpur State: Uttar Pradesh
f)	Latitude & Longitude	North N26028'20" East E 80014'32"
g)	Nearest Railway Station	Panki
h)	Distance of project location from the Railway station	5 Km
i)	Nearest Major Town	Kanpur
j)	Distance of the town from the project site	16 Km.
k)	Nearest Highway from the project site	National Highway - 25
l)	Nearest airport	Kanpur – 25 Km Lucknow – 80 Km
m)	Nearest commercial airport	440 Km
n)		
SITE CONDITIONS (for design purposes)		
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	85 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Siesmic data	Zone-III as per IS: 1893

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3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	$\pm 1425 \text{ kVp}$
3	Switching impulse voltage	$\pm 1050 \text{ kVp}$
4	Power frequency withstand for 1 min (rms)	630 kV(rms)
5	Max. fault level (1 sec.)	50 kA
6	Minimum creepage distance	13020 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	$\pm 10\%$	50 (+5% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	$\pm 10\%$	50 (+5% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second & for 25kA for 1 sec. for 220V DC system.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	Main Bus Level	Jack Bus Level	Peak
400kV	8000mm	15000mm	23000mm	7500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

3.1.4 The minimum clearances for 400kV switchyard shall be as given below:

Phase to earth clearance	3500 mm
Phase to phase clearance	4200 mm
Section clearance	6500 mm

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

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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.

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.

‘Make’ of brought-out items are subject to Owner/Purchaser’s approval.

The bidder shall furnish relevant details to the Owner/Purchaser for his concurrence before procurement. Makes approved by owner shall only be acceptable.

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 CODES AND STANDARDS

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the more stringent of both shall prevail. All work shall be carried out as per the codes and standards listed out in the description of each equipment/item.

Indian Electricity Act and Indian Electricity Rules can be obtained from bureau of Indian Standards.

Equipment complying with other internationally accepted standards such as IEC, BS, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force on date of opening of bid and shall clearly bring out the salient features for comparison.

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

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

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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 inter-pole 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 (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. 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.

After the approval of the drawings, 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 plan 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' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.
- c. All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.
- 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, III within one (1) week 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 (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**
- j. 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.

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.

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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 sixty (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 along with 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 corporate 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 with all relevant pamphlets.
- e. The manuals shall include the following
 - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
- f. A collection of the manufacturer's 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 Operation & Maintenance Manuals

The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

3.5.6 As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions in requisite number.

Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing

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facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.

3.5.7 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. Two (2) bound sets alongwith 4 CD-ROMs of all drawing.
- c. All documents/designs in two (2) copies as noted above.
- d. Contractor shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
- e. The Contractor shall also furnish four (4) copies of instruction/ operations & maintenance manuals (after approval) for all the equipments.

3.5.8 TEST REPORTS

Four (4) copies of preliminary test results shall be supplied for approval prior to despatch of the equipment. Bound copies of complete test results shall be furnished later, in number of copies as per attached Distribution Schedule. These shall incorporate all tests carried out on the equipment and its auxiliaries as well as characteristic curves of current transformers including reports on the official test waves, failure detection data and copies of final test oscillograms of both voltage and current with calibration.

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

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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 TROPICAL PROTECTION

All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.8 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.

3.9 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.

3.10 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.

3.11 DEGREE OF PROTECTION

Degree of protection for various enclosures as per IS: 13947 shall be as follows:

1. LT Switchgear/MCC/DBs/Fuse Boards

- i. Compartments and busbar chambers upto 1600A : IP52
- ii. Compartments and busbar chambers above 1600A : IP42
- iii. Switchgear located outdoor : IP55

2. Motors

- i. Indoor motors : IP55
- ii. Outdoor motors : IP55 with canopy

3. Transformers

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|---|---|-------------|
| i. Indoor Transformer | : | IP22 |
| ii. Cable box-indoor area | : | IP52 |
| iii. Cable box-outdoor area | : | IP54 |
| iv. Indoor kiosks and marshalling boxes | : | IP54 |
| v. Outdoor kiosks and marshalling boxes | : | IP55 |
| 4. Push Button Stations and any other kiosk/box/panel/ enclosure | | |
| i. Indoor | : | IP54 |
| ii. Outdoor | : | IP55 |
| iii. In dusty areas, e.g. conveyor galleries, transfer points, crusher house, bunker floor etc. | : | IP65 |
| 5. Junction boxes for cables/wires | : | IP55 |
| 6. Outdoor lighting fixtures | : | IP55 |

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.

3.12 PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colours shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

3.13 RATING PLATES, NAME PLATES AND LABELS

- 3.13.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
- 3.13.2 Such nameplates or labels shall be of white non hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
- 3.13.3 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.13.4 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.13.5 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

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- 3.13.6 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.
- 3.13.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

3.14 GALVANISING

- 3.14.1 The galvanised surface shall consist of a continuous film adhering to the steel. 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.
- 3.14.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. 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 of zinc 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.
- 3.14.3 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.

3.15 PAINTING

- 3.15.1 All surfaces to be painted including interior and exteriors of enclosures and other metal parts shall be shot or sand blasted or chemically treated to remove all rust, scale, grease and other adhering foreign matters. If not specified or approved otherwise later, colour of finishing paint shall be RAL 7032 with glossy finish except for panels which shall have matt finish. The paints used shall be epoxy-based or of suitable type to withstand the salty atmosphere prevalent in the coastal areas.
- 3.15.2 All metal parts not accessible for painting shall be made of corrosion resistant materials. All machine finished or bright surfaces shall be coated with a suitable rust preventive compound and wrapped or otherwise protected.
- 3.15.3 Paints shall be carefully selected to withstand tropical heat and extremes of weather specified herein. It shall not scale-off or crinkle or be removed by abrasion due to normal handling.
- 3.15.4 Should finished paint chip-off or crinkle during transit or installation, the Contractor shall arrange for re-painting the equipment at site at his own cost.

3.16 QUALITY ASSURANCE

The Contractor shall follow his standard procedures for quality assurance and control. This shall be in standard format indicating test witness and customer hold point shall be submitted for approval by the successful bidder. A copy of the said standard procedures shall be submitted to the Owner/Purchaser for his reference. However, Owner/Purchaser reserves the right to review the same and give his observations, if any, for compliance.

The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges/values, reference drawings etc.

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Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

Manufacturing and quality control procedures shall be available for audit to the Owner/Purchaser and/or its representative at the place of manufacture.

The Owner/Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

The Owner/Purchaser may inspect the Contractor's facilities prior to award of contract.

The Owner/Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

The Owner/Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.17 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 sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. Such programs 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 program shall be generally in line with ISO-9001/IS-14001. A quality assurance program 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 as per format enclosed as Annexure-I.

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3.18 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 13.18.1 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.
- 13.18.2 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.
- 13.18.3 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.
- 13.18.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
- 13.18.5 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 along with technical justification for approval and dispositioning.
- 13.18.6 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch 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.
- 13.18.7 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, chemical 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.
- 13.18.8 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.
- 13.18.9 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 13.18.10 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.
- 13.18.11 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.

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- 13.18.12 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. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 13.18.13 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 13.18.14 No welding shall be carried out on cast iron components for repair.
- 13.18.15 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 13.18.16 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-1A (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 personnel employed and details of co-relation of the test report with the job.
- 13.18.17 In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.
- 13.18.18 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
- 13.18.19 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.
- 13.18.20 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 13.18.21 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractors 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.
- 13.18.22 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.
- 13.18.23 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

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

3.19 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.

1. The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.
Or
2. In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as 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° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

Burn In Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature 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.

During the Burn in 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° C above the ambient temperature.

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

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been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.20 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (v) mark.

Each QA Documentation 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.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.20.1 Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) 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.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) whoever applicable.
- ix) MDCC

3.20.2 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 other agreed manuals/ procedures, prior to commissioning of individual system.

3.20.3 Before dispatch/ commissioning of 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 endeavour to correct the incompleteness, thus allowing finalizing 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.
- i) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier

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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 submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.21 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 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.

3.22 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 3.22.1 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.
- 3.22.2 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.
- 3.22.3 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.
- 3.22.4 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.
- 3.22.5 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.
- 3.22.6 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.

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- 3.22.7 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.
- 3.22.8 To facilitate advance planning of inspection in addition to giving inspection notice, 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.
- 3.22.9 All inspection, measuring and test equipment 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 customer/consultant. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.23 PACKAGING & TRANSPORTATION

3.24.1 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. **Packing shall be done by high quality material suitable for at least 1 yr. storage at site.**
- 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.

3.24.2 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.

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Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor.

3.24.3 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 grounds for claims for extension in time or for extra payment.

3.24 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

- 3.24.1 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.
- 3.24.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.24.3 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.
- 3.24.4 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.
- 3.24.5 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.
- 3.24.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.24.7 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.

3.24.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC 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: / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.
- 3.25.2 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.
- 3.25.3 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.
- 3.25.4 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.25.5 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.
- 3.25.6 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.
- 3.25.7 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.
- 3.25.8 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.
- 3.25.9 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.
- 3.25 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.**
- 3.26.1 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.
- 3.26.2 Mechanism Box/ Control Cabinet/ Kiosks: A sheet steel (atleast 2.5 mm thick), dust and vermin proof M.Box/CCC/CMB shall be provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.
- 3.26.3 Junction Boxes: The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be hot dip galvanised and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures. The terminal blocks provided shall be of 650 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.
- 3.26.4 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.
- 3.26.5 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.
- 3.26.6 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.
- 3.26.7 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.
- 3.26.8 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.
- 3.26.9 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
- 3.26 TERMINAL BLOCKS**

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- 3.27.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 3.27.2 The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 3.27.3 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.
- 3.27.4 The terminals shall be provided with marking tags for wiring identification.
- 3.27.5 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
 - Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.
- 3.27.6 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.

3.27 Wiring

- 3.28.1 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).
- 3.28.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 3.28.3 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.
- 3.28.4 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.
- 3.28.5 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.

3.28 CABLE GLANDS AND LUGS

- 3.29.1 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.
- 3.29.2 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.
- 3.29.3 Cables lugs for power cables shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall

be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.29 CONDUITS, PIPES AND ACCESSORIES

- 3.30.1 The bidder 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.
- 3.30.2 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.
- 3.30.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.30 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- 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.
- Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- Heat run test on contacts
- IR/HV test, etc.

3.31 LAMPS AND SOCKETS

3.32.1 Lamps:

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

3.32.2 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.

3.32.3 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.

3.32 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, 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.

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

3.33 TESTS

General

During manufacture, the Owner/Purchaser's representative(s) shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the Contractor's and their Sub-Contractor's equipment and may reject defective materials considered unsuitable for the intended purpose or which do not comply with the intent of the tender specification. The Contractor, upon any such rejection by the Purchaser or his representative(s), shall replace the defective or unsuitable materials. The Contractor shall provide every reasonable inspection facility to the Purchaser's Inspector(s) or representative(s) at his own and his Sub-Contractor's works.

The Contractor shall give thirty (30) day notice of readiness for inspection of component parts and/or before final assembly and test, so that the Purchaser's representative(s) may inspect the materials and witness such tests before shipment. The Purchaser's representative(s) may, at any time, inspect and request copies of any or all test data of raw materials and finished components which shall be immediately furnished.

Material being furnished against this order shall only be shipped when factory inspection, satisfactory to the Purchaser and/or their representative(s) has been conducted. Such inspection and acceptance for shipment shall not, however, relieve the Contractor from his entire responsibility for furnishing equipment conforming to the requirement of the tender specification nor shall prejudice any claim, right or privilege which the Purchaser may have because of the use or supply of defective or unsatisfactory materials or equipment. Should the inspection be waived by the purchaser, such waiver shall not also relieve the Contractor, in any way, from his entire obligations under the Contract.

The equipment shall, at the factory or after installation, be demonstrated capable of performing satisfactorily upto the Contractor's guaranteed performance. All tests required by the tender specification including retests and inspection that may be necessary owing the failure to meet any tests specified, shall be made at the Contractor's expenses. Additional tests, as necessary, shall be made to locate such failure(s) and after determining the causes of failure(s) and rectifying it, specified tests shall be repeated to establish that the rebuilt equipment meets the tender specification requirements in every respect.

Should the equipment ultimately fail to pass the specified tests, the Purchaser will have the option to reject the unit.

Tests during Manufacture

During the manufacture of equipment, tests specified in Standard Specification(s) shall be performed on each unit in addition to any of manufacturer's standard tests and requisite number of copies of tests certificates as per Distribution Schedule shall be furnished.

Routine Tests

After completion of manufacture routine tests as specified in relevant Standards and in Standard Specification(s) shall be performed on equipment and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

All tests shall be conducted in accordance with Indian Standards in effect at the time of testing and in presence of representative(s) of the Purchaser/ Consulting Engineer.

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Tests on Associated Components

Cast epoxy resin insulators, surge absorbers, current transformers, voltage transformers, control devices and other associated components as applicable, shall be tested in accordance with the relevant Indian standards and/or Manufacturer's Standards.

Type Tests

Contractor will have to submit Type test reports for all equipment for review. The test reports shall be of same or higher rating. In case the test reports are older than 5 years from the date of techno commercial bid opening i.e. 02.11.15 or related to equipment of lower rating then fresh type tests have to be conducted without any implication.

Site Tests

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

Testing Facility

The Bidder shall state in the Proposal the testing facilities available at his works. Should full capacity testing equipment be not available, the Bidder shall state the method proposed to be adopted with detailed computations and justification for adopting such a method to reliably ascertain the equipment characteristics corresponding to full capacity testing.

3.4 Enclosures:

1. ANNEXURE- I – MQP (Customer format)
2. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

ANNEXURE-I

SL. NO	MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN				PROJECT				REMARKS		
			ITEM :	SUB-SYSTEM:			ACCEPTANCE NORMS	REFERENCE DOCUMENT	FORMAT OF RECORD	AGENCY		CONTRACT NO.	
				QP NO.:	REV.NO:	DATE:							M
1.			CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	7.	8.	9.	D*	** 10.	11.	
				4.	5.	6.							
			LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: THE OWNER P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUMN "N"										
MANUFACTURER/ SUB-SUPPLIER SIGNATURE			MAIN-SUPPLIER			FOR THE OWNER USE			DOC. NO.: REV CAT		REVIEWED BY	APPROVED BY	APPROVAL SEAL

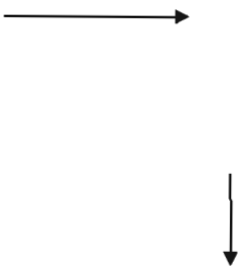


1 x 660 MW - Panki Thermal Power Station

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E2 : SWITCHYARD

ATTRIBUTES, CHARACTERISTICS 	Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per Owner Specification
ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY			
Circuit Breaker (IEC: 56)	Y	Y	Y
Interruptor & hollow Insulator (IEC: 233/ IS: 5284)	Y	Y	Y
Isolator (IEC: 129 / IEC: 694)	Y	Y	Y
Current Transformer (IEC: 185)	Y	Y	Y
Capacitor Voltage Trans former (IEC: 186 / 358)	Y	Y	Y
Bus Post Insualtor (IEC: 168 / 273 / IS:2544)	Y	Y	Y
Disc, Pin & String Insualtor (IEC: 383 / IS: 731)	Y	Y	Y
Long Rod Insualtor (IEC: 433)	Y	Y	Y
Surge Arrestor (IEC: 99-4)	Y	Y	Y
Hardware fittings for Insulator (IS: 2486 / BS: 3288)	Y	Y	Y
Spacer Clamps & Connector (IS: 10162 / 5561)	Y	Y	Y
Aluminum Tube (IS: 5082 / 2673 / 2678)	Y	Y	Y
Wave Trap (IEC: 353 / IS: 8792 / 8793)	Y	Y	Y
Conductor (IS: 398-P-II)(V)	Y	Y	Y
Galvanised Steel Structures (IS: 2062/2629/4759/6745)	Y	Y	Y
Vibration Damper (IS: 9708)	Y	Y	Y
Sag Compensating Spring DIN: 2089/2096 IS: 3195 / 7906	Y	Y	Y
Control & Relay Panel	Y	Y	Y
SF6 Gas filling & evacuating plant	Y	Y	Y
SF6 Gas Leak Detector	Y	Y	Y
Leakage Current Analyser	Y	Y	Y
Nitrogen Gas Filling Device	Y	Y	Y



Protection Relays	Y	Y	Y
Event Logger	Y	Y	Y
Operation Analyser	Y	Y	Y
Disturbance Recorder	Y	Y	Y
Tariff Metering System	Y	Y	Y
Synchronising Trolley	Y	Y	Y
Relay Test Kit	Y	Y	Y
LT Switchgear /LT Panels (IEC:947 / IS:13947)	Y	Y	Y
Battery IS:1652	Y	Y	Y
Lighting Panels	Y	Y	Y
Surge Monitor	Y	Y	Y

Notes:

- 1) This is an Indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.
- 2) All major Bought Out Items will be subject to Owner/ Owner Engineer approval.

SECTION 4

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 1 CHECK LIST FOR INFORMATION TO BE FURNISHED
WITH THE OFFER

ANNEXURE 2 SCHEDULE OF DEVIATION

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

BIDDER SHALL PUT A TICK '✓' IF THE INFORMATION IS ENCLOSED WITH THE OFFER, PUT A CROSS 'X' IF THE INFORMATION IS NOT ENCLOSED OR WRITE 'NOT APPLICABLE' IF THE QUERY/ SCHEDULE IS NOT RELEVANT AND RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BIDDER:
OFFER REFERENCE:

- | | |
|--|-------|
| 1. Technical offer with detailed schedules of equipment/ material and spares | _____ |
| 2. Schedule of Deviations listing deviations, if any, clause-wise with respect to technical specification | _____ |
| 3. List of past supplies complete with Purchase Order & Project name, quantity, order reference, etc., where identical equipment have been supplied. | _____ |
| 4. Manufacturer's Quality Plans for approval | _____ |
| 5. Field Quality Plan for approval | _____ |
| 6. General Arrangement drawings with dimensions and weights and foundation/ fixing details | _____ |
| 7. Drawing/ data submission Schedule | _____ |
| 8. Type test reports. The type test reports shall be accompanied with a list listing all the relevant clauses of the applicable standard and the corresponding type test report. The manufacturer shall also furnish a certificate certifying that the test reports have been carried out on equipment identical in all respects to the one offered. In case the reports are for a different equipment and the applicability of the report is permitted as per applicable standards, the justification shall be enclosed to the list of type test reports. | _____ |
| 9. Bar Chart showing time schedule showing time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning | _____ |
| 10. Makes of all important components, like motors, operating switches, fuses, etc. | _____ |
| 11. Any additional information called for in any part of the technical specification. | _____ |

Date:

Signature of the authorized representative of Bidder

Company Seal

SCHEDULE OF DEVIATIONS

Certified that the following are only deviations from the specification (for the equipment and systems being offered)

S.No.	Page No.	Clause No.	Deviation	Reason / Justification
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Date :

Signature :

Name:

Designation :