



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

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TITLE Fibre Optic Telecommunication System				DATE			
				GROUP	TBEM		
				W.O. No	84007		
CUSTOMER	Tamil Nadu Generation and Distribution Corporation						
PROJECT	400kV GIS at 2x660MW Ennore SEZ						

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of the Telecommunication equipments/items, survey, planning, co-ordination with other supplier's equipment, design, manufacture, testing at works, packing, dispatch, supervision of erection and site testing & commissioning of SDH equipment, termination equipment & Telecommunication Management Network (TMN) complete with accessories as listed under this specification.

This section covers the specific technical requirements of SDH equipment, termination equipment & EMS/NMS. This constitutes minimum technical parameters for the above item as specified by the customer. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements & Bill of Quantities

Section-2: Equipment Specification

Section-3: Project Details and General Technical Requirements

Section-4: Guaranteed Technical Particulars

Section-5: Enclosures

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

Note: It may be noted that the word “contractor“ wherever is referred in section-2 shall be read as bidder and word “employer“ wherever is referred in section-2 shall be read as Tamil Nadu Generation and Distribution Corporation.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer : Tamil Nadu Generation and Distribution Corporation

Name of the Project : 400kV GIS at 2x660MW Ennore SEZ

Refer Section - 3 for Project Details and General Specifications.

1.2 BILL OF QUANTITIES

1.2.1 The BOQ for this package is enclosed in Annexure-A.

The bidder is required to submit their offer for supply and services as per BOQ and technical specification.

1.2.2 The breakup details of FOTE equipment & other communication accessories required for integration of 400kV Ennore station is furnished in the enclosed BOQ.

1.2.3 It is the bidder's responsibility to integrate the proposed OLTE equipments in the above Project with the existing communication equipments / newly proposed equipments at the remote end stations.

1.2.4 It is the bidder's responsibility to supply the entire accessories such as SFPs (including Remote ends), connecting cables, patch chords, LIUs etc, needed for the integration of

OLTE and multiplexer with remote end equipments. The price of same shall be included in the quoted price.

- 1.2.5 It is the bidder's responsibility to integrate the proposed FOTE equipments with the existing communication equipment/ newly proposed equipments at remote end substations. Any item not specifically mentioned in the BOQ or technical specification, but is required for integration with remote end FOTE/ required to ensure compatibility between new and existing equipment shall be in bidder's scope of supply and shall be included in the quoted price.
- 1.2.6 Necessary DC-DC converters if required for successful operation of the offered equipments shall be in bidder's scope of supply.
- 1.2.7 Proposed SFPs shall be compatible for all types of OLTE equipments as per IEC standard.
- 1.2.8 Any other items like rack mounted DCDB, hardware, communication cable, jumper cable, krone tool, pre-connectorized optics fibre patch cord, signal cables, E1 cables etc. which are required for completion of the system are deemed to be included in the offer. BHEL will provide only 1.1kV Cu control and Al auxiliary power supply cables for external system cable connections and 48V DC system (Battery/Charger/Main DCDB).
- 1.2.9 Any other commissioning/ technical support required for system commissioning to the satisfaction of Customer/ BHEL and Link budget calculation is deemed to be included in the offered price. No price implication shall be entertained during execution and handing-over of the system.
- 1.2.10 Required quantity of Panels/ Cabinets for housing OLTE/ PDH/ Digital Protection Coupler/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.
- 1.2.11 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.
- 1.2.12 All equipments supplied at each station shall be suitable for operation with the remote end existing equipments for successful commissioning of the links. No price implication shall be entertained during contract stage regarding the same.
- 1.2.13 SAT & Commissioning of Tele-Communication System including Supervision of Installation covers both local and remote ends for successful commissioning of each link.
- 1.2.14 Necessary site visits before quoting for this tender for collection of existing system data for proper co-ordination and interfacing with the remote end existing equipments shall be in bidder's scope.
- 1.2.15 Prices for additional Optical amplifiers, additional patch cords etc. as required to meet the requirement of line lengths specified shall be included in the quoted price for respective SFP/ Optical Interface Cards.
- 1.2.16 All SFP's shall be suitable for mounting in the SDH cabinets being offered.
- 1.2.17 Some of the items may not be ordered at all.

1.2.19 Anything not mentioned above but which may be required at a later stage as per site condition shall also be provided for successful data, voice and protection inter-trip signal integration. The price of same shall be included in the quoted price.

1.2.20 The overall contract value may vary by +/- 30%.

1.3 TECHNICAL QUALIFYING REQUIREMENTS:

Please refer Annexure-D

1.4 TYPE TEST REQUIRMENTS

The bidder shall submit the type tests reports for the tests conducted on the equipment similar to those to be supplied under this contract and the test(s) should have been conducted at an independent laboratory not earlier than five (5) years prior to date of supply.

In case the bidder is not able to submit valid report of the type test(s) or in case type test report(s) are not found to be meeting the specification requirements, or not including all specified tests the bidder shall conduct all such tests. The cost of such test shall be borne by the bidder without cost and delivery implication to BHEL. The BHEL/owner shall have right to witness the type tests. Waiver of type tests will not be entertained in normal circumstances.

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

1.5 INSPECTION, TESTING AND ACCEPTANCE

Bidder has to follow specification and Customer approved Manufacturing Quality Plan and FAT/SAT procedures.

1.6 DEVIATION

The offer of bidder shall be as per technical specification. No deviation from the same will be accepted. NIL deviation sheet should be signed and attached with offer.

1.7 DOCUMENTATION

Final Documentation (after approval) shall be submitted separately for each Substation.

1.8 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) Filled checklist
- d) Un-priced Bill of Quantity
- e) Documents in support of PQR

1.9 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 1 year) 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.

1.10 ENCLOSURES TO SECTION -1

- | | | |
|----|------------|--|
| 1) | ANNEXURE-A | : BOQ OF OLTE |
| 2) | ANNEXURE-B | : Existing F.O Network & Proposed stations. |
| 3) | ANNEXURE-C | : Details of equipment in adjacent stations to the proposed station. |
| 4) | ANNEXURE-D | : Technical Qualifying Requirement. |

TANGEDCO ENNORE OLTE EQUIPMENT BOQ			
Sl. No.	Item Description	Unit	Quantity
			TOTAL
1	Optical Line terminal equipments STM4/16 SDH suitable for 6 directions (MSP) & 1G/10G MPLS-TP port suitable for 6 directions with main & standby. (OLTE suitable for both SDH & MPLS-TP technology) as per Technical specification except from Sr.no. 2 to 21 below.	Set	2
2	PDH Multiplexer with cross-connect for 16 E1 ports	No.	2
3	Optical Ethernet S4.1 SFP	Nos.	4
4	Optical Ethernet L4.2 SFP	Nos.	2
5	L4.2x SFP/ Optical Interface Card for 100 km	Nos.	2
6	10/100Mb Layer 2 type 4 port Ethernet module	Nos.	2
7	4 port Differential protection card, compatible with C37.94 standard,8 directions	Nos.	4
8	4 port Differential protection card, compatible with C37.94 standard, 2 directions & has to be interfaced with ABB make FOX 615 OLTE (Remote end)	Nos.	6
9	8 command stand alone Digital Protection coupler , medium shall be G.703,co-directional with E1 electrical & optical interface	Nos.	14
10	Patch Cord of 20m length (suitable type as per site requirement	Nos.	50
11	Hybrid EPAX with Analog/VOIP/Digital/PLCC interface Cards (each card with 16 subscriber & 50 trunks & spare modules	Set	1
12	4 pair Telephone cable (0.6mm)	kM	4
13	Telephone	Nos.	6
14	IP Phone	Nos.	16
15	S4.1 SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	2
16	L4.2 SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	4
17	L4.2x SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	2
18	4 Port Differential protection card (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	2
19	S 16.2 SFP	Nos.	10
20	L 16.2 SFP	Nos.	10

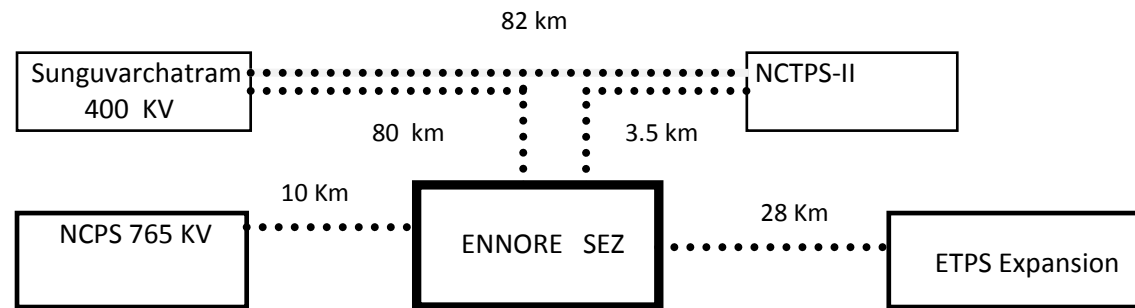
21	EMS/NMS for OLTE & Multiplexers	Set	1
	Mandatory Spares		0
22	20% of the total quantity as per BOM in the project shall be supplied as spares,item-wise & type wise such as SFPs (of all types),sub rack, all types of modules (including SDH module,PDH module,power supply module, alarm module etc.)	Lot	1
23	Connectors for DDF connectivity	Nos.	25
24	Baluns (75 Ohms to 120 Ohms) for DDF connectivity	Nos.	25
25	Co-axial cable for DDF connectivity	kM	0.5
26	Optical patch chords of 20 mtr length with suitable connectors at both ends	Nos.	90
27	Tools & Tackles:Crimping tools suitable for crimping the connectors and cables supplied	Set	3
28	Surge protection devices for supplied OLTE, Multiplexer & Digital protection coupler	Set	6
	Services		
29	Services : Training for 6 (Six) No. of TANTRANSCO Engineers on SDH, PDH Multiplexers and interface for differential protection/ protection inter-trip (as per clause 2.25 of Section-II) for a duration of 5 (Five) days at Manufacturer works.	Lot	1
30	Services : Lodging and boarding Charges for 6 (Six) Nos. of TANTRANSCO Engineers for a duration of 5 (Five) days at manufacturer works.	Lot	1
31	Services : To and Fro charges of 6 (Six) Nos. of TANTRANSCO Engineers for the Training at manufacturer works.	Lot	1
32	Services : Splicing of Fibres at Both ends of Link , including splicing at respective FODPs. (Link Wise)	Lot	4
33	Services :a) Support services as per clause 2.18 of Section-II of TS) b) Services for SAT (As per clause 2.5 of Section-II of TS) , GSAT (As per clause 2.6 to 2.10 of Section-II of TS) and Commissioning of Telecommunication system including Supervision of Installation (Link Wise)	Lot	4
34	Services : Maintenance & Technical support services (as per clause 2.14 , 2.17 , 2.19 & 2.20 of Section-II o f TS)	Lot	1

STATION WISE BREAK UP OF ABOVE BOQ

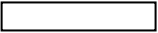
Required OLTE EQUIPMENT BOQ								
Sl. No.	Item Description	Unit	Quantity					
			400kV Ennore end	400kV NCTPS Stage-II	400kV Sunguvarchatram	400kV ETPS EXP	400kV North Chennai Pooling Station	TOTAL
			New Station	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	
1	Optical Line terminal equipments STM4/16 SDH suitable for 6 directions (MSP) & 1G/10G MPLS-TP port suitable for 6 directions with main & standby. (OLTE suitable for both SDH & MPLS-TP technology) as per Technical specification except from Sr.no. 2 to 16 below.	Set	2	0	0	0	0	2
2	PDH Multiplexer with cross-connect for 16 E1 ports	No.	2	0	0	0	0	2
3	Optical Ethernet S4.1 SFP	Nos.	4	0	0	0	0	4
4	Optical Ethernet L4.2 SFP	Nos.	2	0	0	0	0	2
5	L4.2x SFP/ Optical Interface Card for 100 km	Nos.	2	0	0	0	0	2
6	10/100Mb Layer 2 type 4 port Ethernet module	Nos.	2	0	0	0	0	2
7	4 port Differential protection card, compatible with C37.94 standard,8 directions	Nos.	4	0	0	0	0	4
8	4 port Differential protection card, compatible with C37.94 standard, 2 directions & has to be interfaced with ABB make FOX 615 OLTE (Remote end)	Nos.	0	2	0	2	2	6
9	8 command stand alone Digital Protection coupler , medium shall be G.703,co-directional with E1 electrical & optical interface	Nos.	8	2	2	2	0	14
10	Patch Cord of 20m length (suitable type as per site requirement	Nos.	50	0	0	0	0	50
11	Hybrid EPAX with Analog/VOIP/Digital/PLCC interface Cards (each card with 16 subscriber & 50 trunks & spare modules	Set	1	0	0	0	0	1
12	4 pair Telephone cable (0.6mm)	kM	4	0	0	0	0	4
13	Telephone	Nos.	6	0	0	0	0	6
14	IP Phone	Nos.	16	0	0	0	0	16
15.1	4 Port SAMO II module (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	0	0	2	0	0	2
15.2	S4.1 SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	0	0	2	0	0	2
15.3	L4.2 SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	0	0	4	0	0	4
15.4	L4.2x SFP (suitable for ABB make FOX 615 already available in Sunguvarchatram 400Kv SS end.)	Nos.	0	0	2	0	0	2

Required OLTE EQUIPMENT BOQ								
Sl. No.	Item Description	Unit	Quantity					
			400kV Ennore end	400kV NCTPS Stage-II	400kV Sunguvarchatram	400kV ETPS EXP	400kV North Chennai Pooling Station	TOTAL
			New Station	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	Existing Station (ABB Make FOX 615)	
15.5	4 Port Differential protection card (suitable for ABB make FOX 615 already available in Sunguvarchatram 400kv SS end.)	Nos.	0	0	2	0	0	2
15.6	S 16.2 SFP	Nos.	2	2	2	2	2	10
15.7	I 16.2 SFP	Nos.	2	2	2	2	2	10
16	EMS/NMS for OLTE & Multiplexers	Set	1	0	0	0	0	1
17	Mandatory Spares							0
17.1	20% of the total quantity as per BOM in the project shall be supplied as spares,item-wise & type wise such as SFPs (of all types),sub rack, all types of modules (including SDH module,PDH module,power supply module, alarm module etc.)	Lot	1	0	0	0	0	1
17.2	Connectors for DDF connectivity	Nos.	25	0	0	0	0	25
17.3	Baluns (75 Ohms to 120 Ohms) for DDF connectivity	Nos.	25	0	0	0	0	25
17.4	Co-axial cable for DDF connectivity	kM	0.5	0	0	0	0	0.5
17.5	Optical patch chords of 20 mtr length with suitable connectors at both ends	Nos.	50	10	10	10	10	90
18	Tools & Tackles:Crimping tools suitable for crimping the connectors and cables supplied	Set	3	0		0	0	3
19	Training as per clause 2.25 of section-II of TS	Lot	1	0	0	0	0	1
20	Services							
20.1	Splicing of Fibres (Link-Wise)	Lot	4	0	0	0	0	4
20.2	SAT & Commisioning of Tele-Communication System including Supervision of Installation (Link-Wise)	Lot	4	0	0	0	0	4

EXISTING F.O. NETWORK & PROPOSED STATIONS IN THIS TENDER



.....

-  Newly proposed stations
-  Existing stations
-  Ennore SEZ station

ANNEXURE-C : Details of equipment in adjacent stations to the proposed station.

DETAILS OF EQUIPMENT IN ADJACENT STATIONS TO THE PROPOSED STATION

Sl. No.	Name of the station	Adjacent station	Eqpt. In adjacent station	
2.	Ennore SEZ 400 KV	NCPS 765 KV	Fox 615	
		NCTPS stage-II	Fox 615	
3.		Ennore Expansion	Fox 615	
		Sunguvarchatram 400 KV SS	Fox 615	

ANNEXURE-D

TECHNICAL QUALIFYING REQUIREMENTS:-

The bidder should have designed, tested, supplied and commissioned OLTE equipments for 400kV system or above to Electricity boards/ Power utilities in India during the last Ten (10) years and the same should have been in satisfactory operation(#) for a minimum period of Two years as on date of of techno-commercial bid opening of this tender.

(#) Satisfactory operation means certificate issued by the Customer certifying the operation without any adverse remark.

PART-II
TECHNICAL SPECIFICATION**SECTION-I****1.0 INTRODUCTION****1.1 GENERAL:**

TANTRANSCO intends to establish Fibre Optic Communication links, through Optical fibres between the locations given below and Synchronous Digital Heirarchy (SDH) equipments and PDH Multiplexers with interface for Protection inter-trip or Digital Protection Coupler for its own communication needs.

Sl. No.	Station – A	Station – B	Distance between A & B in Kms.
1.	Ennore SEZ 400 kV SS	ETPS Expansion 400 kV SS	28
2.	Ennore SEZ 400 kV SS	NCPS 765 KV	10
3.	Ennore SEZ 400 kV SS	NCTPS stage-II	3.5
4.	Ennore SEZ 400 kV SS	Sunguvarchatram 400 kV SS	82

The requirement of STM cards, SFPs and Ethernet modules are as given in Price schedule. The requirement are given considering future stations to be established also.

2.0 SCOPE:

The scope of the project includes:

- a) Design, engineering, manufacture, transport, installation , testing and commissioning of Synchronous Digital Heirarchy (SDH) equipments and PDH Multiplexers with Cross connect & with standalone Digital Protection couplers.
- b) integrating the new F.O. links with the existing F.O. network.
- c) Provision of an efficient Element Management System licensed to accommodate atleast 300 Network Elements and capable to accommodate atleast 400 Network Elements.
- d) All cabling, wiring, patch facilities, equipment DDF's and interconnections to the supplied equipment side of the defined interfaces.
- e) Supply of testing instruments & mandatory spares.

3.0 EXISTING COMMUNICATION FACILITIES:

Details of Existing PDH Multiplexers, and SDH equipments in adjacent stations to the proposed stations are shown in Appendix-I.

4.0 The following points were considered for arriving the BOQ referred above.

Optical Attenuation per Km. of fibre = 0.3 dB

Sl.No.	Equipment Description	Tx level(dB)	Rx threshold dB	Margin available dB
1.	STM-1-S-1.1	-12.0	-28	16
2.	STM-S 1.2/S 4.2(short haul)	-12.0	-28	16
3.	STM L.1.2(longhaul)	-5 to 0	-34	29 to 34
4.	STM L.1.2x(extra longhaul)	0 to +5	-34	34 to 39
5.	STM-L.4.2 (longhaul)	-3 to +2	-28	25 to 30
6.	STM-L.4.2x(extra longhaul)	0 to +5	-36	36 to 41

Sl. No.	Name of the Fibre Optic Link	Dist. Km	Fibre Loss @ 0.3 dB/ Km in dB	Connector loss dB	Mtce. margin dB	Tx-Rx margin required dB	Eqpt. Type proposed	Tx-Rx Margin available dB
1.	Ennore SEZ 400 kV SS-ETPS Expansion 400 kV SS	28	8.4	1.0	3.0	13	STM-4- S 4.2	16
2.	Ennore SEZ 400 kV SS-NCPS 765 KV	10	3	1.0	3.0	7	STM-4- S 4.2	16
3.	Ennore SEZ 400 kV SS-NCTPS stage-II	3.5	1.05	1.0	3.0	5	STM-4- S 4.2	16
4.	Ennore SEZ 400 kV SS-Sunguvarchatram 400 kV SS	82	24.6	1.0	3.0	29.0	STM-4-L-4.2x	36

5.0 GENERAL REQUIREMENTS:

The work covered by this specification shall include design, manufacture, factory tests, supply, training, installation, cabling, field tests and commissioning of SDH equipments and PDH Multiplexers with Digital Protection couplers to be provided by the Contractor. The Bidder is encouraged to offer standard products and designs. However, the Bidder must conform to the requirements and provide any special interface equipment necessary to meet the requirements stated herein. **It should be**

noted that all preliminary design information (such as distance between stations) are provided for bidding purposes only. The Contractor is responsible for the final design and system performance.

The Bidder's proposal shall address all functional requirements within this specification and shall include sufficient documentation to provide reviewers with compliance particulars without further necessity for inquiries.

A comparison of the functional requirements of this specification to the performance characteristics of the bidder's offering may lead to conclude that additional items (hardware/software) are required that are not specifically mentioned in this specification. The bidder shall propose and be responsible for providing these items such that a viable and fully functional communication network is implemented. Such materials shall be considered to be within the scope of the contract , whether specifically called out or not in the specification or in the contract schedules and should be identified as a part of the bidder's proposal. The bidder shall not be eligible for extra charges for such material.

The wideband network shall utilize state- of-art equipment to provide communication services necessary for the operation of the power system. All equipment provided shall be designed to interface with existing equipment and shall be capable of supporting all present and future requirements identified in this specification. The specified spare capacity requirements for new equipment shall also be identified.

The communication equipment shall be designed as to provide for expansions and reconfigurations without impacting normal operation, including adding and removing circuits. It shall be designed to operate in varying environments, such as those requiring special enclosures to provide protection against rodents, contaminants, vibration and electro-magnetic interference.

6.0 GENERAL RESPONSIBILITIES AND OBLIGATIONS:

This section describes the Contractor(s) and Employer's general responsibilities and obligations.

Contractor's Responsibilities and obligations:

The Contractor shall be responsible for all cables and wiring associated with the equipment provided. The Contractor shall also be responsible for determining the adequacy of the local power source for the equipment and for wiring to it with adequate protective breakers. In addition, the contractor shall be responsible for shielding equipment and cabling to eliminate potential interference to or from the equipment and for earthing all cabinets and shields.

The Contractor's obligations include, but are not limited to, the following:

- a. Engineering, design, transfer of technology , training of Employer representatives, supply, testing, integration, delivery to the stores/site, unloading, storing, handling and moving to the final position, installation, testing and commissioning for successful commercial operation of the system.
- b. Equipment engineering and design specific to each site where equipment and systems supplied on this project will be located, including review of conformance with local environmental and earthing considerations.
- c. Engineering and technical assistance during the contract and warranty period.
- d. Equipment necessary to ensure compatibility between new and existing equipment.
- e. All hardware, software and firmware required to satisfy the requirements of this specification.
- f. Factory and field testing of the all hardware, Software and firmware provided.
- g. Providing a Quality Assurance Plan ensuring Employer access to the manufacturing process.

- h. Installation and integration of all Contractor(s) supplied communications equipment into the existing network.
- i. All documentation and drawings as specified.
- j. All required spare parts, spare cards price, maintenance aids, and test equipment.
- k. All cables and wiring needed to expand/supplement existing Digital Distribution frames (DDF) as necessary for proper operation of the wideband network.
- l. An availability analysis showing MTBF (mean-time-between-failure) and MTTR (mean-time-to-repair) figures for all system components.
- m. Planning for a smooth transition from existing operations to network operations, including all new equipment.
- n. Hardware, software, and firmware maintenance, debugging and support of the equipment through final acceptance and maintenance on all new equipment through the warranty period.
- o. Availability of service, spare and expansion parts for all equipment for a minimum period of **10** years from the date of operational acceptance by Employer or 7 years after the declaration of withdrawal of equipment from production whichever is later.
- p. Any minor modifications such as drilling necessary holes in floors for laying the cables will be the responsibility of the Contractor.
- q. Supply, laying and termination of cables from AC/DC panels to the equipment supplied by the Contractor will be the Contractor's responsibility.
- r) Provision of separate Communication earth as per the requirement(Pipe in Pipe technology) or as per standards.
- s) Necessary optical attenuators shall be provided wherever required as per the prevailing field conditions.

Employer's Responsibilities and Obligations:

The Employer will provide the following items and services as part of the Project.

- a) Review and approval of the Contractor(s) designs, drawings and recommendations.
- b) Arranging necessary shut downs and work permits at various sites.
- g) Communication network configuration data.
- h) Interconnection drawings for existing equipment, including MDFs.
- i) Review and approval of test procedures.
- j) Participation in and approval of "type" factory and field tests.
- k) Review and approval of training plans.
- l) Providing support and access to facilities at the sites.
- m) Coordination of the Contractor's activities with the Employer's Operations and other departments.
- n) Obtaining statutory clearances from regulatory bodies, which includes No-objection from Department of Telecommunication for the wideband network.
- p) Implement the necessary renovations, expansions or construction of facilities required for the equipment to be provided by the Contractor.

8.0 APPLICABLE STANDARDS:

The SDH equipment shall fulfill the latest version of ITU-T , ETSI & ISO standards and recommendations including the following minimum requirements:

- 1) Functional characteristics; G.957,G-783, G-764.
- 2) Transmission interface characteristics:
 - Optical fibre: G-652,G.653, G.655.
 - Optical interface G-707, G-957.
 - Output jitter (all optical interfaces): G-783, G-823,G-825.
 - Jitter tolerance(all optical interfaces) G-823,G-825.
 - Jitter transfer function(all optical interfaces) G-783.
 - Mapping & Demapping G-707.
 - SOH insertion and extraction G-707, G-783.

Specifications and codes shall be the latest version, inclusive of revisions, which are in force at the date of the contract award. Where new specifications, codes, and revisions are issued during the period of the contract, the Contractor(s) shall attempt to comply with such, provided that no additional expenses shall be charged to the Employer without the Employer's written consent.

In general, compliance with ITU-T/ITU-R, ISO, BIS, IEC and IEEE standards as applicable, shall be mandatory as a minimum. Exceptions shall be documented and submitted for Employer approval.

9.0 FUNCTIONAL REQUIREMENTS

The primary function of the communications network is to provide a highly reliable voice, data and protection inter-trip signal transport system. A brief summary of wideband communication system requirements follows:

1. **The Synchronous Digital Hierarchy(SDH) shall be of the state of the art and capacity – STM-4 or STM-1 as given in the schedule separately as per latest ITU standards with complete redundancy and protection. The PDH Multiplexer and Digital Protection couplers shall be as per latest ITU-T & IEC standards.**
2. The equipment shall have Engineering Orderwire and over head channels.
3. The equipment shall support Ethernet ports and Ethernet cards shall be provided as per Bill of Materials.
4. Local and remote status alarm supervision facilities.
5. Element Management System.
6. Alternative routing system as defined below.
7. The equipment shall support differential protection protocol C 37.94 standard & adequate cards shall be provided for feeder differential protection which shall be compatible to other end FOTE/Multiplexer equipment.

10.0 ALTERNATE ROUTING:

All fibre optic terminal equipments provided shall have redundant optical port. It shall be possible to provide alternate routing through these ports in future without any need for any additional hardware and software except for fibres. **It shall be also possible to reroute the traffic from one direction to other, in case of fibre problem in one direction in case of ring network.**

If during the development and deployment of the network, configuration schemes providing alternate routing opportunities are identified, there should be a cooperative effort between the Employer and the Contractor to pursue and implement these, insofar as it does not negatively impact terms and conditions of the contract nor the requirements in this specification.

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PART-II SECTION-II

**SDH EQUIPMENTS, PDH MULTIPLEXERS with cross connect and Interface
for Protection inter-trip & Digital Protection couplers DETAILED**

TECHNICAL SPECIFICATION

SCOPE:

The following SDH equipments, PDH Multiplexers with cross connect & Digital Protection couplers are to be supplied, erected and commissioned in the substations noted against them:

Schedule A:

Sl. No.	Name of the station	Quantity required			No. of SDH links to be connected	Differential protection interface cards (C 37.94 compatible)
		STM-1/4 SDH	PDH Multiplexer with Cross-Connect	Digital protection couplers (8 command)		
1.	Ennore SEZ	3 Nos.	1 No.	10 Nos.	6 directions (MSP)	4 nos. (4 port card), 8 directions.
2.	NCPS 765 KV(FOX 615 equipment available)	--	--	--	--	2 nos. (4 port card), 2 directions suitable to fix in FOX 615 FOTE equipment.
3.	NCTPS stage-II (FOX 615 equipment available)	--	--	2 nos	--	2 nos. (4 port card), 2 directions suitable to fix in FOX 615 FOTE equipment.
4.	Ennore Expansion	--	--	2 nos.	--	2 nos. (4 port card), 2 directions suitable to fix in FOX 615 FOTE equipment.
5.	400 KV Sunguvarchatram SS	--	--	2 nos.	--	--

SDH Equipment :

The SDH equipment shall be of STM-1 and upgradable to STM-4 capacity by mere replacement of Small Form factor Pluggable (SFP) as given in the schedule.

The specified fibre optic transmission data rate is defined in multiples of CEPT standard E1s as described in ITU-T/CCITT Recommendation G.703.

FOTS shall be designed to utilize the fibre optic cable, in conformance with ITU-T/CCITT recommendation G.652, G.653 and G.655.

Functional Requirement:

The optical transmit function of a Fibre optic Terminal shall accept and equalize HDB3 coded electrical inputs that shall meet ITU-T Recommendation G.703. Combined with the Service Channel and In-Service Monitoring (ISM), the HDB3 coded bit stream shall be converted for injection into the optical fibre.

The optical receive function shall reconvert the optical signal into electrical signals, separate ISM and the Service Channel and deliver an equalized HDB3 coded electrical output that meets ITU-T Recommendation G.703. SDH minimum transceiver characteristics are specified in table 2-1. Fibre Optic Transceiver characteristics.

In the SDH Terminal configuration, two transceivers shall be configured as to provide Primary and Secondary paths for the link.

Table -2-1 - Fibre Optic Transceiver Characteristics

Optical Wavelength	1310/1550nm *NOTE
Optical Source	Laser.
Optical Source Lifespan	Better than 5 X 10 ⁵ hours
Optical Fibre type	DWSM
Optical Connectors	Type ST-PC Option 1 Type FC-PC Option 2
Jitter Performance	Per ITU-T Recommendation G.823
Source Primary Power	-48Vdc
Relative Humidity, non-condensing	10-100%
Elevation: Operating Non-operating	To 3000 meters To 10000 meters

Temperature Range: - To Manufacturer's Specification. - Operation without damage - Shipping/storage.	(Non-environmentally controlled) 0 to + 50° C -10 to + 55° C -40 to + 60° C
<u>Temperature Stabilization:</u> Meet or exceed operational performance requirements through entire temperature range as specified in Section .	
<u>Eye Safety for laser Equipment:</u> 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.	

* **NOTE:** Optical wavelength shall be selected considering the characteristics of the optical fibre and the link budget.

Service Channel:

Service channels shall be provided as a function of the SDH.

Supervision and Alarms:

ISM circuitry shall be provided as a function of the SDH. Local visual alarm indicators shall be provided on the equipment and as dry-contact pin-outs. F1 Type local craftsperson terminal interface and/or remote equipment monitoring is required. **At a minimum, SDH terminals shall provide alarms as specified in Table 2-2.**

Table-2 -2 Fibre Optic Terminal Alarms:

Alarm	Cause
LED/Laser Failure	Drive Current Low Threshold Drive Current High Threshold
Receive Failure	Optical Receive Low Threshold
Transmit Frame Alarms	HDB3 Loss of Input Distant Alarm Indication Signal (AIS) Local AIS
Receiver Frame Alarms	BER > 10 ⁻³ BER > 10 ⁻⁶
Regulator Alarm	Clock Recovery (Synchronization Loss)
Power Supply/Converter Alarm	Failure, Low Voltage Thresholds
Quality Parameters.	Per ITU-T Rec. G.821/G.826

Higher Order Multiplexing:

The base digital interface is defined at the CEPT standard E1. Configuration specifics shall require that SDH equipment support multiples of E1 port requirements. Higher order multiplexing of multiple E1s shall be provided as part of the SDH.

Digital Distribution Frame (DDF) and Patching Facilities:

One No. 21x E1 DDF for each station shall be provided and all the 21 E1s shall be wired.

SDH equipment requirement:

1. The equipment shall be modular in design and flexible for capacity expansion either by plugging of modules in the prewired spare slots or by adding additional shelves to existing racks, without need for rewiring or relocating existing equipment.
2. All capacity expansion shall be non disruptive to existing traffic under all circumstances.
3. It shall be hot swappable.
4. The equipment shall be able to work continuously in non air-conditioned environment at all sites proposed.
5. The equipment shall be immune to Electromagnetic , RF interference generated by nearby source and shall meet the latest international standards in this regard.
5. The SDH equipments shall be configurable as STM-1 or STM-4, with suitable type of SFP (Small Formfactor Pluggable).
6. The SDH equipment shall support GFP –F encapsulation for Ethernet data.
7. It shall support Status Message Scheme(SSM) for SDH timing.
8. Network protection timing shall be as per ETSI/ITU.

Power supplies:

The SDH equipment shall have its own power supplies with fuses, isolators etc., The Power supply shall have over voltage, under voltage, short circuit, reverse

power and surge protection. As soon as the normalcy in voltage, current and surge conditions are restored, the power supply unit shall restart on its own without need for manual switching.

**Redundant power supply unit shall be provided in each equipment and there shall not be any sharing of loads between power supply units.
Surge protectors shall be provided for both the power supply inputs.**

Cross connect:

The switching sub system or cross connect in the SDH equipment shall be non-blocking, It shall have full connectivity , timing transparency, time sequence integrity and assured correctness of cross connection.

The SDH equipment shall be capable of interfacing a wide range of input interfaces including SDH, PDH signals, Ethernet/Fast Ethernet ports in an integrated manner. It shall be possible to support all network topologies –bus, hub, ring, mesh and mixed to support network evolution in future.

Optical module:

All Optical ports including optical ports in spare cards shall be provided with SFP for 1550 nm. Short haul equipments may be provided with SFP suitable for 1310 nm.

Ethernet module:

- 1. 2 Nos. 4 port , 10/100 Mb, Layer-2 type Ethernet interface
(Electrical) shall be provided with all SDH equipments.**

The following features shall be supported in this module

SFP Slots for Gigabit Ethernet Optical – 2 Nos.

ETH ports minimum 4 port

ETH 10/100 Base T.

Auto sensing.

Flow control 802.3x configurable (On/Off)

EoS mapper.,

ITU-T G.707 (Virtual concatenation)

G7041 (GFP) or X.86(LAPS) configurable.

G.7042(LCAS)

Interface with Protection relays:

In all power utilities protection inter-trip facility is provided to transfer the trip command received in a protection relay (Differential Line Protection & Distance Protection relay) at one end of a 230 kV and above level transmission line to be transferred through communication media to the relay at the other end of the line to clear the faulty line at both ends. The distance protection relay will provide a contact output whereas the output from differential protection relay will be an optical output of standard IEEE C37.94 MM at 820 nm/C37.94 SM at 1300 nm.

Interface card for Differential Protection:

The interface card shall be suitable to interface 4 trip command optical inputs of standard IEEE C37.94 MM at 820nm or C37.94 SM at 1300 nm from Differential Protection relays and 4 trip command outputs of standard IEEE C37.94 MM at 820nm or C37.94 SM at 1300 nm to Differential Protection relays independently. The interface card shall have two output ports towards SDH equipment and it shall be possible to cross connect any or all inputs to any one of the output port. It shall be possible to connect each output port to different fibres. In addition the interface card shall have facility to transmit & receive 4 Nos. binary inputs/outputs independently apart from command inputs and outputs, in a similar method as described above for commands.

Interface card for Protection Inter-trip (Distance protection):

The interface card shall be suitable to interface 4 trip command inputs and 4 trip command outputs independently. The interface card shall have two output ports towards SDH equipment and it shall be possible to cross connect any or all inputs to any one of the output port. It shall be possible to connect each output port to different fibres. In addition the interface card shall have facility to transmit & receive 4 Nos. binary inputs independently apart from command inputs and outputs, in a similar method as described above for commands.

The Interface cards for Differential Protection/Protection Inter-trip shall be compliant with tele-protection standard IEC 60834. It should have been tested for

EMI/EMC compliance and type test reports in this regard shall be furnished along with the offer.

- a) These cards shall be software programmable.
- b) Performance requirements:
 - c) a) Transmission time less than or equal to 12 mS.
 - d) b) Fail to trip: $< 1 \times 10^{-5}$.
 - e) c) False trip: $> 1 \times 10^{-3}$
- f) Additional points:
 - g) All inputs and outputs shall be galvanically isolated.
 - h) Cross connect and drop insert facilities for binary inputs shall be possible.
 - i) Point to multipoint operation is required.
 - j) 4 binary signals per 64 Kbps channel.

The number of Protection interface cards required is furnished in the Schedule-A.

Alternatively

(Standalone digital protection coupler is recommended as per site condition, if the other end FOTE equipment is of other vendor make)

Digital Protection coupler as per the specification below shall be provided alongwith the SDH & PDH Multiplexer.

DIGITAL PROTECTION COUPLER:

General:

Protection coupler to be used in 230 KV lines with distance protection scheme is permissive under reach scheme, single phase, single shot, auto re-closure scheme.

The protection coupler equipment shall be provided in such a manner that the time interval, between the instant the trip signal is received from the protection relay on the transmitting end and the instant trip signal is received at the protection relay at the receiving end for any of the above scheme shall not be more than 12 mS.

The protection coupler offered shall have input and output capacity of 8 channels each.

The protection coupler shall be provided with interconnecting/interfacing unit suitable for connection with Differential Protection Relay or Distance Protection relay. It shall be possible to test the operational reliability of the protection channel from both ends of the channel. Necessary test prints, push buttons and lamps shall be provided for this purpose. During healthy conditions of the line the test procedure shall not initiate any tripping command.

However, if a genuine trip signal is received during the testing process, the test function shall be completely blocked and overridden. i.e., the trip signal must have absolute priority.

The equipment offered shall not be sensitive to corona noise and impulse type of noise. Both visual and audible alarm should be provided. To connect to external audible alarm two potential free relay contacts shall be provided in the alarm circuit.

Three dry contacts may be provided for each trip output.

Even if trip impulse is momentarily received, the trip output relay should be held operated for not less than 50 mS. Failure of Protection coupler should not cause any trip output to protection relay.

The input and output relay and contacts should be capable of carrying continuously 5A at 220 V DC/110 V DC selectively, which is nothing but station voltage.

External counters shall be provided in the coupler for Tx & Rx separately for each command, failing which the bid is liable for rejection.

The Protection Coupler shall be of Digital version.

The digital transmission medium shall be G.703, co-directional, with a transmission speed of 2 Mbps.

It shall be possible to use V.11 interface or Optical fibre interface, at a later date by mere replacement of the interface module.

The Protection coupler shall be compliant with tele-protection standard IEC 60834. It should have been tested for EMI/EMC compliance and type test reports in this regard shall be furnished along with the offer.

The Protection coupler shall be software programmable.

Performance requirements:

a) Transmission time less than or equal to 7 ms.

b) Fail to trip: $< 1 \times 10^{-5}$.

c) False trip: $> 1 \times 10^{-3}$

Additional points:

All inputs and outputs shall be galvanically isolated.

Cross connect and drop insert facilities for binary inputs shall be possible.

Point to multipoint operation is required.

8 binary signals per 64 Kbps channel.

Sl.No. (1)	DESCRIPTION (2)	Particulars (3)
1.	Digital medium	G.703
2.	Transmission speed	2 Mbps.
3.	Communication interface	G.703 (2 Mbps) Co-directional interface.
4.	No. of commands transmitted	Eight commands simultaneously.
5.	Command input detail	Opto electronic input 24 V to 250 V DC , 1 ms selectable by HMI. Duration of pulse programmable from 1-250ms.
6.	Command output	Solid state relay contacts. 1 working contact 290 VDC (Max) 2A Max. Short circuit current 100A/30ms.
7.	Alarm relay output : Voltage rating : Current rating : No. of dry contacts.	Yes 290 V AC max. 5 A max. 2 Neutral contacts
8.	Power supply operation range : a) Operating Voltage Range b) Operating Temperature Range	36-72 V DC -10 to +55 deg.C

9.	Test facilities for local loop test and End to End test.	Shall be provide for local & remote end.
10.	Visual and audible alarm provided or not	Visual Alarm through LED & 2 Alarm contacts shall be available.
11.	Transmission time (maximum)	< 7 ms with protection coupler in permissive/ direct/blocking mode of operation with data rate of 2 Mbps.
12.	Performance under noise conditions. a. Fail to trip PMC (max. actual transmission time less than 20 ms) probability of Missing command (Dependability).	$< 1 \times 10^{-5}$
13.	b. False trip PUC (probability of unwanted command) (Security)	$> 1 \times 10^{-3}$
14.	Power consumption.	15 W Max.
15.	Whether technical pamphlets and drawing enclosed or not	Yes
16.	Compliance to Teleprotection standard IEC 60834.	Yes
18.	Compliance to IEC-61000 standards	Shall be compliant
19.	a. Programmable entirely with PC. b. Built in event recorder of 255 events with 1 ms. Precision. c. Possibility of daily automatic link check.	Shall be possible. Shall be available. Shall be possible

System Availability:

The system availability shall be greater than 99.9%. System BER shall not exceed 1×10^{-12} . Theoretical calculations shall be submitted in support of the above for all the links with 1 hour MTTR.

Clock signal:

The system shall have its own internal clock for synchronisation purpose. Also it shall have the capability to regenerate clock signal from the 2 Mb stream received from nearby station. The system shall also accept external clock signal to be given from any reference station.

The priority of working of the clock signals is as below:

1. External clock from reference station.
2. Clock regenerated from 2 Mb stream
3. Internal clock.

1. PDH Multiplexer:

The hardware of PDH Multiplexer shall be equipped to support following functionalities along with voice and data channel units:

- A) Terminal PDH Multiplexer
- B) Protected terminal PDH Multiplexer
- C) Drop-Inset and Bypass PDH Multiplexer
- D) Cross connect PDH Multiplexer

It shall be totally software configurable without any hardware settings.

The systems in the network shall be manageable through central EMS or via. Local Craft Terminal (LCT).

The offered PDH Multiplexer shall work on 48 V DC +10 % /-15%

It shall support 30 channel time slot content either voice or data.

It shall have provision for security provision via pass word, for preventing unauthorized access to PDH Multiplexer configuration.

It shall have at least two programmable alarm outputs.

It shall be capable of supporting following voice interfaces:

- a) 2W/4W E&M
- b) FXS with hot line configuration option
- c) FXO

It shall be possible to configure Tx & Rx levels for voice channels.

The PDH Multiplexer shall be capable of supporting following data interfaces:

- a) Ethernet interface Layer-1 type (Transparent bridging, Minimum 2x 10 Base –T LAN ports with nx 64 Kbps WAN bandwidth)
- b) V.35 interface
- c) X.21 interface
- d) V.11 interface
- e) V.24/V.28 interface
- f) G.703 interface
- g) 2 B1Q interface
- h) The data interface unit shall support sub rate multiplexing.
- i) It shall be possible to drop/insert any channel up to n x 8 Kbps granularity for low speed RS 232 data channels.

Clocking:

The PDH Multiplexer shall be able to drive the clock from multiple sources and it shall be possible to assign priority between these sources.

In case of failure of highest priority clock, the next in line shall take over automatically and so on.

Modularity and Hot swapability.

It shall be possible to increase the capacity by addition of modules.

All capacity expansion shall be non disruptive to existing traffic under all circumstances.

It shall be hot swappable.

Configuration of PDH Multiplexer:

- | | |
|---|----------------------------------|
| 1. PDH Multiplexer rack | - 1 No. |
| 2. Cabinet with complete wiring, MDF & DDF | - 1 No. |
| 3. Power supply module | - 2 Nos. |
| 4. Control card | - 2 Nos. |
| 5. 2 Mb interface card (for min. 2 x 2 Mb) | - 1 No. or as per Mfr. standard. |
| 6. 2W/4W E&M card for 8 voice channels | - 1 No. or as per Mfr. standard. |
| 7. FXS card 2W-sub loop/hot line for 8 subscribers | -1 No.or as per Mfr.standard. |
| 8. FXO card for 8 channels | -1 No.or as per Mfr.standard. |
| 9. Low speed data interface card V.24/X21 for 4 channels- | 1 No. or Mfr. standard. |
| 10.N x 64 Kbps data interface card V.35 for 4 channels- | 1 No. or Mfr. standard. |

11. Ethernet interface card 4 channels (Layer-1 type)- 1 no. or as per Mfr. standard.

12. Cross connect shall be provided with minimum 16 output ports and shall have the provision to add output ports in steps of 4 or 8 at later stage.

ELEMENT MANAGEMENT SYSTEM (EMS):

General:

Element Management System (EMS) shall be provided as a part of this procurement. This EMS shall provide the capability to monitor, reconfigure, and control elements of the equipments supplied under this procurement. The above capability shall be provided at centralized location, Chennai. The EMS shall be capable of managing minimum of Hundred Nos.(300 Nos.) Network Elements and shall be upgradable to manage 400 Nos. Network elements minimum in future.

EMS shall provide display of faults for complete equipments under this contract at central location, Chennai. Following types of faults management shall be provided by EMS:

- 1) Real Time alarm monitoring
- 2) Alarm acknowledgement
- 3) History of alarms storage & retrieval

The EMS supplied by Contractor shall be capable of upgrading to support an Integrated TNMS.

Technical Characteristics – General:

The management system should follow the ITU-T Recommendations. Management Framework (IS 7498-4), which defines the following management facilities needed by the Employer as follows:

- a) Configuration management.
- b) Fault management
- c) Performance management
- d) Security management

CONFIGURATION MANAGEMENT

General Requirements:

Configuration management is concerned with management, display, and control of the network configuration. Specific requirements that shall be satisfied include the following:

- a. Provide tools to establish and maintain the backbone topology and configuration information and provide graphical maps depicting the configurations.
- b. Gather descriptive information about the current configuration of the equipment, provide operator displays, and prepare report.
- c. Provide tools for planning, establishing, and changing the static equipment configuration. Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.
- d. Provide verification testing to support new equipment installation.
- e. Provide a database capability to maintain various types of information, such as:
 - 1. Network equipment assets, including manufacturer, model number, maintenance record, and maintenance telephone contact.
 - 2. Future data to be defined by Employer after commissioning.

Fault Management:

General Requirements:

Fault management is concerned with detecting, diagnosing, bypassing, directing service restoral, and reporting on all the equipments supplied under this tender. Specific requirements that shall be satisfied include the following:

- a. Display equipment status in a consistent fashion regardless of the source of the data on a graphical topological, map-type display. Status shall be displayed through the use of colours on links and nodes as well as through text.
- b. Obtain status and detect faults through periodic polling, processing of unsolicited alarms and error events, and periodic testing for connectivity.

- c. Maintain an alarm summary of unacknowledged alarm events on the management station display and maintain a log of all received alarms. The operator shall be able to acknowledge and clear alarms individually and as a group. The use of alarm correlation techniques is encouraged to minimize the proliferation of alarms caused by a single, common event.
- d. Provide the capability to diagnose and isolate failures through analysis of error and event reports and through the use of both on-line and off-line diagnostic tests and display of monitored data.
- e. Bypass failures through the use of automatic failover to redundant equipment where possible and through operator-initiated actions where automatic failover is not possible. The criteria for failover shall be configurable. As an example, the NMS shall support the transfer of switching orders to hot-standby fibre terminal equipment configurations and drop insert equipment .
- f. Track network equipment failure history.

Power Failure:

After a power failure, all equipment shall return without any manual reset to the same mode as before the failure.

Performance Management:

General Requirements:

Performance management is concerned with evaluation of the use of network equipments and their capability to meet performance objective. Specific requirements that shall be satisfied include the following:

- a. Monitor point to point and end to end signal quality & history.
- b. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:
 - 1. Select/deselect network equipments, events, and threshold parameters to monitor.
 - 2. Set monitoring start time and duration or end time.
 - 3. Set monitoring sampling frequency.

4. Set/change threshold values on selected performance parameters.
5. Generate alarm events when thresholds are exceeded.
6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.
7. Provide graphical displays of current point to point and end to end performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
8. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

Security Management:

General requirements:

The EMS shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel.

Authentication techniques shall be provided to verify the identify of anyone trying to access the EMS or any operator interface where network parameters may be viewed or changed.

Command security shall be ensured, if possible through use of redundant data communication channels providing command results annunciation and alarms if command is not executed.

Access methods shall be provided to limit access to only authorized users of the EMS. At least three levels of access shall be provided – none, read only, and write. With “read only” access level, network parameters should only be viewed. Access to database maintenance, command control and test functions shall be available with “write” access level. Means shall be provided to ensure only one authorized user has “write” capability for a selected domain of the network. It shall be possible to define multiple domains for purposes of monitoring and control.

Human error and conflict detection are also required. Such errors and access violations shall be reported to the offending user as error messages & warnings. Repetitive violation of security measures shall generate an intrusion alarm, which

shall be logged and displayed at all authorized operator management stations. Physical intrusion detected should be reported as an alarm condition.

Operator Authorization Levels:

Two levels of operator authorization, as a minimum, shall be provided.

- a. Monitoring Level: Monitoring Level operators are authorized to supervise the network, but should not be able to change the configuration of the network.
- b. Master Level: Master Level operators can supervise the network and carry out protected functions such as change network configuration & other functions such as database maintenance functions. Authorization at the master level may encompass the whole network or only a part of it.

Monitoring Level

A monitoring level operator shall have access to at least the following items or features:

- a. Diagram of the network.
- b. Name of network elements (NE).
- c. Connections between NEs.
- d. Faults in NEs.
- e. Faults in lines.

After the selection of a link or a network element, the operator shall have access to the following information:

- a. All signals with status between two NEs.
- b. All input signals with status to NEs.
- c. All output signals with status from NEs.
- d. Faults in plug-in unit level.
- e. Equipped units in subrack.
- f. Unequipped units in subrack.
- g. Priority levels (class)

Master Level:

The master level operator shall be able to make the following configuration changes:

- a. Increase the number of NEs.
- b. Create new or revised connections between two network elements.
- c. Decrease the number of NEs.
- d. Remove the connections between two network elements.

Alarm Indications:

The following types of alarms shall be provided as a minimum in addition to other alarms generated as described above.

- a. Transit frame alarms (e.g. input data failed)
- b. Receiver frame alarms (e.g., $BER > 10^{-3}$ or $> 10^{-6}$)
- c. Receiver alarms (e.g., AGC at max)
- d. Switch over requested.
- e. Power supply alarms.
- f. Quality parameter indications according to ITU-T recommendation G.821 (erroneous seconds, highly erroneous seconds, degraded minutes).

Equipment Requirements:

In general the minimum monitoring and control requirements for the communications equipment are summarized in Tables 2-3 through 2-5.

Table-2-3-Fibre Optic Transmission Equipment Alarms and Indicators:

1	Device Status
2	LED/Laser drive current
3	Transmit Output Power Failure
4	Transmit Frame Alarms
5	Receiver Frame Alarms
6	Receiver Alarms
7	Quality Parameter Indicators
8	Loopback Actuated Indicator
9	Configuration Status
10	Power Supply/Converter Alarms

Table -2-4- Higher Order Multiplex Equipment Alarms and Indicators:

	Device Status
	Clock Supply Failure
	Loss of Frame Alignment
	Frame Parity Check Failure
	Quality Parameter Indicators
	Configuration Status
	Tributary Alarms
	Loopback Actuated Indicator
	Power Supply Alarms

Table 2-5- Station Alarms, Indicators and Controls

1	<i>Intrusion Detection alarms</i>
2	Power Failure
3	Fire and Smoke Detection
4	Environmental Control (temperature, humidity, etc.)

NMS Configuration:

Each node on the backbone network shall include provision for connecting a laptop PC to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the local operator shall be able to:

- a) Change the configuration of the station.
- b) Perform tests.
- c) Get detailed fault information.

The Laptop P.C. shall be connected to Ethernet/Management interface available at terminal and repeater stations. **Two** identical portable (Laptop) computers, each complete with necessary system and application software to support the functions listed above, shall be provided.

Interfaces:

The EMS shall be equipped with graphic workstations in the stations which are defined in the scope of supply.

A Q1 – interface (ITU-T Rec. G.771) is required for network elements as defined in ITU-T Recommendations.

The Bidder shall include the detailed information of the interfaces, especially concerning the lower layer protocols and bit rates supported.

EMS Architecture:

The EMS architecture shall be described in detail in the proposal. The following subsystems or features shall be described:

- a. Database used in EMS.
- b. Desktop PC, hardware, software and operating system.
- c. Graphic display terminals.
- d. Laptop PCs.
- e. Data communication between nodes and EMS computer.
- f. Maximum number of Network elements that could be handled and number of systems.
- g. License details.

Environmental Requirements:

All equipment and systems shall be designed to operate in the following environmental conditions which are a subset of the above referenced standards.

Temperature and Humidity

Most of the equipment will not be installed in environmentally controlled shelters. Therefore, equipment shall operate in accordance with the limits specified below:

Temperature Range:	(Non-environmentally controlled)
To Manufacturer's Specification	0 to + 50 °C
Operation without damage	-10 to + 55 °C
Shipping/storage	-40 to + 60 °C
Max rate of change of temp	0.5 °C / min

Ventilation	Natural
Relative Humidity, non-condensing	10 – 100 %

Biological Conditions:

All telecommunication equipment shall withstand the influences of flora and fauna as per latest standards. The equipment and components shall be suitably tropicalized during manufacture through commissioning, as necessary.

Chemical Influence:

All telecommunication equipment shall withstand the chemically active substances sea salts, sulphur dioxide, hydrogen sulphide, chlorine, hydrogen chloride, hydrogen fluoride, ammonia, ozone and nitrogen oxides as per latest standards

Vibrations and Shocks:

All telecommunication equipment shall withstand mechanical conditions (vibrations and shocks) during transportation, handling and under installed condition as per latest standards.

Electromagnetic compliance:

The equipments offered shall meet the EMI/EMC compliance as per IEC-801.

Protection Classes:

The equipments supplied shall comply with IP44.

Identification:

All cabling, equipment, racks/enclosures (cubicle), modules and material shall be uniquely identifiable as per the following.

Equipment Labelling:

Labelling of equipment shall be adequate to enable its correct location, and to facilitate routine testing and maintenance. All labels shall be clear, durable and securely fixed.

Power Distribution:

Inter-rack and intra-rack (enclosure) power distribution shall be clearly identified with source feed, voltage and power rating information. All power feed cabling shall be clearly identified near the point of termination.

Signal Cabling:

Connectorised signal cabling/wiring requires marking with a unique identifier at each connectorised end. The signal cable/wire identifier shall include a cable identifier and the location of both terminations.

Signal cable/wiring installed on terminal blocks requires marking with the cable identifier and distant end location. The cable tag shall be clearly visible at the cable fanout point.

All signal cable, wiring and terminations shall be clearly labelled/tagged with identifiers consistent with Contractor supplied cable plant records. Marking techniques are subject to approval by the Employer.

Connectors and Sockets:

As a general requirement to avoid problems of silver migration, all contacts on printed circuit boards should be gold-flashed or gold-plated.

Power supply units with/without stabilizers shall be protected with voltage trip and overload current circuits. Recovery after a fault shall be automatic for input over/under voltage and manual for output over/under voltage and over current condition.

Heavy Duty Surge Protector Requirements:

High quality surge protector/diverter of reputed make shall be provided by the contractor, for each equipment.

Cabling:

All signalling cables within the telecommunication system, and the power supply cables are part of contractor's delivery and installation. Signal cables and power supply cables shall be placed apart from each other (minimum distance 150 mm).

Redundant cables and cables to redundant equipment shall be placed in separate cable routes.

All Contractor supplied inside plant cables and cable assemblies shall be constructed from non-PVC, fire/smoke resistant materials.

Compliance of standards:

The SDH equipment shall fulfill the latest version of ITU-T , ETSI & ISO standards and recommendations including the following minimum requirements:

Functional characteristics; G.957,G-783, G-764.

Transmission interface characteristics:

Optical fibre: G-652.

Optical interface G-707, G-957.

Output jitter (all optical interfaces): G-783, G-823,G-825.

Jitter tolerance(all optical interfaces) G-823,G-825.

Jitter transfer function(all optical interfaces) G-783.

Mapping & Demapping G-707.

SOH insertion and extraction G-707, G-783.

Equipment Shelf:

An equipment shelf be provided to hold all equipment modules and shall provide a backplane for system power and inter module communications. The shelf shall be capable of being mounted on a standard EIA 19 inch rack. If more than one shelf is required at any site, multiple shelves shall be combined and shall function as one integrated node.

TESTING OF EQUIPMENTS:

2.5 SITE ACCEPTANCE TESTS

Following are the Site Acceptance Tests to be carried out in different stages of installation, erection, testing and commissioning:

- a. Pre-Commissioning Period - The Phase 1 Site Acceptance Test (SAT) including Pre-Commissioning tests.
- b. Commissioning Period - The Phase 2 SAT
- c. Guarantee Test - Guaranteed System Availability Test.

2.5.1 Site Acceptance Tests

2.5.1.1 The Site Acceptance Test (SAT)-I.

Site Acceptance Test for Telecommunication Equipment and Subsystems

Site acceptance test for telecom equipment and subsystems shall be conducted in two phases

(a) Phase 1 SAT (Installation & Pre-Commissioning tests)

This phase includes SAT for all equipment & systems procured under the present tender.

(b) Phase 2 SAT (Integrated System Tests)

The second phase SAT covers the tests for overall integrated telecommunications system comprising all equipments.

The Phase 2 SAT shall commence after completion of the Phase 1 SAT. The contractor has the overall responsibility for planning and ensuring the success of the Phase 2 SAT.

2.5.2.1 Phase 1 SAT

I. Installation Testing

The Phase 1 SAT consists of installation testing of the termination equipment. The Contractor shall connect all inputs, and communications circuits (making all of the necessary adjustments) and verify the operation of these circuits. The field installation test shall be performed for all equipment at each location. If any equipment has been damaged or for any reason does not comply with this Specification, the Contractor shall provide and install replacement parts at its own cost and expense.

The minimal installation testing requirements for the fibre optic and network management subsystems are provided in Tables 2-6 and 2-7.

Table- 2-6 Fibre Optic System Installation Testing

Item	Description
1.	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Power supply/converter voltage measurements
3.	Terminal transceiver performance testing
4.	Service channel performance
5.	User interface, alarm and control functional performance
6.	Rack and local alarms
7.	Network management interface and supervision performance
8.	Input/Output interfaces
9.	Safety and signaling earthing system
10.	Simulation of failure conditions and failover of protected components

Table- 2 -7 - Network Management Subsystem Installation Testing

Item	Description
1.	Physical inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Power supply/converter/UPS voltage measurements
3.	Workstation hardware inventory, configuration and characteristics
4.	Demonstration of proper operation of all hardware, including workstations peripherals

II Pre-Commissioning Tests

The pre-commissioning tests shall verify that communication between each test site can be performed. During this testing, actual link measurements should be made on each fibre optic link to verify compliance with designed system performance specifications.

This phase of testing shall be conducted by the Contractor and witnessed by The Employer. Field adjustments should be made to meet established standards. However if the field adjustments fail to correct the defects the equipments may be returned to the Contractor with no obligation to the Employer. The exact content of the pre-commissioning tests shall be determined jointly by the Contractor and The Employer. Table-2-8 summarises the minimum requirements for pre-commissioning testing of the wideband communications network.

Table -2-8 Fibre Optic Network Field Communications Testing

Item:	Requirement Description:
1.	Verification of margins and link performance
2.	Bit error rate measurements
3.	Measurement of error seconds
4.	Confirmation of channel assignments
5.	Point-to-point checkout of each new VF/data channel installed

6.	Verification of predicted link margins
The above tests shall be performed after final alignments, correction for test Equipment calibration and with measured transmit power adjusted (attenuated if necessary) to reflect guaranteed performance as noted in the Contractor's documentation.	

2.5.2.2 Phase 2 SAT (Field Integrated System Test)

The tests for the Phase 2 SAT shall include the following tests for systems supplied.

- (a) Routine tests as can conveniently be applied on site together with any other which shall be agreed between the Contractor and the Employer.
- (b) System tests including in test configuration, all the equipment to satisfy the requirements of technical Specification.
- (c) Functional system tests to check the error-free and secure interfacing operationally between the existing systems and those delivered under this Package.

Testing and, specifically, cutover shall be accomplished in a manner that will minimize the possibility of a communication system failure. The work will be scheduled with the Employer in order to accomplish an orderly completion of the work with minimum interruption to the Employer's normal operation. This may require performing some of the work after normal working hours or on weekends to minimize exposure to inadvertent outages.

The intent of the Phase 2 SAT (field integrated system test) is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and commissioning tests have been corrected, and that the communication equipment is compatible with other equipment at all locations. The Integrated System Test shall include all fibre optic and termination subsystems, and the network management subsystem.

2.6 Guaranteed System Availability Test (GSAT)

The telecommunications systems shall be subjected to a Two hundred (200) hours Guaranteed System Availability Test after installation at site and before being put into commercial service.

The purpose of this test is to ensure in advance, the in service availability of the system and its component parts. Successful completion of this test with no more than an agreed number of unscheduled errors (to be agreed between the Contractor and the Employer) will constitute the hardware and software acceptance of the system.

2.7 GSAT Duration and Acceptance Deadline

The duration of the GSAT test shall be 200 hrs. If the Contractor is unable to demonstrate to TANTRANSCO's satisfaction that the system has attained the acceptance conditions during an initial period of nine (9) days, then the acceptance period shall continue on a rolling basis up to an acceptance deadline of 18 days.

2.8 General Conditions for GSAT

The duration of the availability test shall be 200 hours.

During the availability test time. no adjustment shall be made to any equipment, unless specifically agreed with the Employer. During this period, in the event of failure of a unit/component the defective item shall be replaced by a spare unit/component without interruption of the test, if possible and the damaged item shall be repaired and returned to its original position as quickly as possible.

By mutual agreement any period of running with faulty equipment may be regarded as not part of the test.

If the break of the test occurs due to errors in excess of those defined, the test- will be deemed as failed, and the Employer may require the test to be repeated from the beginning.

Prior to the commencement of the tests. the behavior of the system to errors which are monitored by the software shall be demonstrated to the Employer as required. A schedule of alarm/failure printout and display messages will be required before such a demonstration.

No additional program or data shall be read into the system except with the approval of the Employer. Following any such changes a printout may be requested to be made of the contents of specified memory locations.

In the case of standby equipment. no automatic switchover to any alternative standby unit will be permitted, except when the switchover itself is being tested

either manually or automatically.

Internal checking routines which cause the equipment to correct an error automatically will be accepted, providing that no hardware switchover or disconnection occurs and that the test is otherwise correct in all details.

2.9 Test Program for GSAT

A test program or set of test programs shall be submitted for approval to the Employer before the commencement of the test.

The program shall be sufficient to demonstrate compliance with the Test Procedure Specification and the program shall be designed to frequently check the operation of routines/parts which may normally be entered only rarely, as well as exercise all modules to prove the absence of interaction during interleaved operations.

It should also be designed to simulate the system loading expected in order to expose any unforeseen software timing problems which may result in delays in updating or loss of data.

The general test program shall include and interleave the following tests and provide the facilities as follows.

- a. Functional test of all functions.
- b. Functional test of all input, output, display and control equipment.
- c. Printout of both internal and external faults which may not be readily recognizable.
- d. Other tests necessary to meet the requirements of the Specification.

The general test program shall have a short cycle time which shall be according to agreement and shall be run continuously during the test period.

2.10 Acceptance Conditions

The Contractor shall agree with the Employer to a number of unscheduled errors per 20 hrs. above which the equipment will be deemed as having failed the tests. The Bidder shall state in the technical proposal, the minimum number of errors expected to be achieved.

The tests shall be deemed successful only if the following conditions are satisfied:

- a. The total allowable outage time is not exceeded.

- b. No errors in excess of the agreed figure and the system have run without corrections for a period of not less than 20 hrs in the availability test.
- c. Satisfactory results of functional tests.
- d. No series of errors/faults on a particular item, indicating a design weakness.

Should any equipment, or part of it, fail under test to give the required performance, further tests which are considered necessary by the Employer shall be carried out by the Contractor and the whole cost of the completed tests shall be borne by the Contractor. These requirements shall apply equally for tests on Subcontractor's equipment.

After satisfactory completion of the witnessed tests at the Contractor's factory, the equipment shall be submitted for approval during dismantling prior to shipping. No item of equipment shall be despatched to site until the Employer has given his approval in writing.

2.14 MAINTENANCE SUPPORT

2.14.1 Contractor Maintenance responsibility During the Guaranteed Availability Period

The Contractor shall guarantee continuous availability of the system at 99.9% for a period of one year commencing on the date of handover of the system to The Employer. During this period, The Contractor shall replace or repair all detective parts and shall have prime responsibility for maintaining and operational system .

For this period, commencing immediately after operational acceptance, the actual availability achieved during the period would be calculated jointly by the contractor's representative and The Employer. The contractor shall take continual actions to ensure the guaranteed availability. In case the actual achieved availability falls short of the guaranteed availability, it would be considered as contractor's default. However before declaring the contractor's default the Employer shall negotiate for reaching a mutually acceptable agreement.

2.14.2 Continuing Maintenance Concept

After the Guaranteed Availability Period, all normal maintenance will be undertaken by TANTRANSCO.

2.15 Spare Parts and Test Equipment

The following mandatory spares shall be supplied.

1. 20% of the total quantity as per BoM in the project shall be supplied as spares, item-wise and type-wise such as SFPs(of all types), sub-rack, all types of modules(including SDH module, PDH module, power supply module, alarm module etc.,). Any fraction of quantity should be rounded-up to the next higher number.
2. 25 Nos. of connectors, 25 Nos. of Baluns (75ohms to 120 ohms) and 500 mtrs. of co-axial cable for DDF connectivity.
3. **One set of crimping tool for each substation(3 nos) suitable for crimping the connectors and cables supplied.**
4. **6 Nos. of surge protection devices in respect of OLTE, Multiplexer & Digital Protection couplers shall be supplied.**
5. Tools & tackles required for wiring.

2.16 Miscellaneous Supplies

The Contractor shall provide all required consumable and non-consumable supplies necessary to support all installation and test activities through final operational acceptance.

2.17 Maintenance support facilities in India

The Bidder shall describe his own maintenance support capabilities and facilities in India, in his technical bid.

2.18 Support Services

Throughout design, implementation, factory testing, and field installation and testing, the Contractor shall supply consulting assistance, as required by the Employer for site preparation, field installation. and other areas where technical support may be required.

Most locations have existing communications equipment. The Employer is concerned about cutover procedures for an orderly transition incorporating the new communications equipment. In

general, incorporation of the new equipment will take place on a per-loop basis. The Contractor shall review the Employer's existing equipment, make cutover recommendations, and prepare a detailed field implementation plan for phasing in the new equipment and expanding the existing network.

The Contractor shall be responsible for minor facility renovation, equipment installation, startup of all equipment and maintenance of the communications equipment up to and including successful completion of the system availability test.

The Employer personnel will be available to assist the Contractor during installation and field testing of the communications equipment. However, the primary responsibility for successful installation and field testing of the equipment rests with the Contractor.

After final acceptance of the communications equipment, the Contractor shall offer continuing technical support and spare parts for the communications equipment for a minimum of 15 years, or for seven years beyond the announced withdrawal of equipment from sale, whichever is greater.

2.19 Technical Support

Consultation with Contractor's technical support personnel and trained field service personnel shall be readily available on a short-term/long-term basis to assist the Employer personnel in maintaining, expanding, and enhancing the telecommunication network upon expiration of the warranty period. The Contractor shall include in their offer(s), a proposal for ensuring continued technical support as stated above.

2.20 Continued Module Maintenance Support Plan

The Contractor shall provide continued module maintenance support that will ensure immediate faulty module replacement

without waiting for the receipt of faulty module, thus reducing transportation delays. The plan shall ensure that after the expiration of the warranty period, replacement modules shall be dispatched without awaiting receipt of the defective modules.

Details of the plan shall be submitted by the Contractor as part of the offer as a separately priced optional item.

2.22 DOCUMENTATION

2.22.1 General Documentation Requirements

All the documentation shall be provided in hard copy and also on CD in full compliance with the specifications. To ensure that the proposed telecommunications network conforms to the specific provisions and general intent of this Specification, the Contractor shall submit documentation describing the telecommunication network, systems, subsystems and equipment to The Employer for review and approval. The Employer shall have the right to require the Contractor to make any necessary documentation changes to achieve conformance with the Specification, at no additional cost to The Employer.

Documentation for the Contractor's standard hardware, software, and firmware shall be furnished to the Employer for review, but approval by the Employer will not be required. The Employer, however, reserves the right to determine that this standard hardware, software and firmware is in full conformance with the contract requirements and that the documentation contains sufficient information for the Employer to make this determination.

2.22.2 Test Documentation

The Contractor shall provide documentation for all factory and field tests.

The test documentation shall include the following:

- a. Test Procedure Document
- b. Type test documents
- c. Factory Acceptance Test Documents
- d. Site Acceptance Test Documents
- e. Availability Test Documents

Factory Acceptance Test results will be included in factory test data.

Test results, for any unwitnessed equipment tests, shall be shipped along with the associated equipment.

2.23 Drawings

Each drawing submitted by the Contractor shall be clearly marked with the Employer name, the unit designation, the specification title, the specification number and the name of the Project. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in metric units.

2.24 Document Quantities

All final textual documentation shall be provided on CD and hard copy acceptable to the Employer, and already in use by the Contractor is proposed. All drawings shall be provided on electronic media in AutoCAD.

2.25 TRAINING:

The Contractor shall give training for six numbers of TANTRANSCO's Engineers on the SDHs, PDH Multiplexers and Interface for Differential Protection/Protection Inter-trip for a duration of five days at the works. The training shall cover installation, erection, testing and commissioning of the equipments, Hardware & Software of the equipments and EMS including configuration of all equipments. The entire training expenses including to & fro, Boarding, lodging etc., shall be borne by the contractor.

oOo

PART-II- SECTION III

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS(GTP) FORMS

GTP Form 1

**GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION
EQUIPMENT (SDH)**

Manufacturer: Model #:

Seq.	Parameter:	Unit:	Particulars:
1.	Capacity Aggregate Bit-rate: CEPT E-1 Ports:	Mbps n x E1	
2.	Is higher order Multiplex in-built unit of SDH	Yes/No	
3.	Protection SDH = 1:1 APS E-1 Ports = 1:1 APS	Yes/No	
4.	Unprotected System Gain for BER 10^{-3} : BER 10^{-6} :	dBm	
5.	1 + 1 APS System Gain for BER 10^{-3} : BER 10^{-6} :	dBm	
6.	MTBF Unprotected: 1+1APS Protected:	Hours	
7.	Code Format:		
8.	List Optical Coupling options:		

GENERAL SDH FEATURES:

9. Remarks:

OPTICAL TRANSMITTER			
Seq.	Parameter:	Unit:	Particulars:
10.	Source (LED or Laser)		
11.	Source wavelength:	Nm	
12.	Source spectral width:	Nm	
13.	Mean launched power Maximum: Nominal:	dBm	
14.	Launch power during safety Power-down due to fibre break:	dBm	
15.	Stability (nominal power variation due to temperature and/or biasing):	%	
Date:	-continued-	Signature:	
Place:		Name:	
Seal:		Designation:	

Seq.	Parameter:	Unit:	Particulars:
16.	Source rise time:		
17.	Source estimated life span:	Hours	
18.	Source extinction ratio:		
19.	Low power alarm Threshold: field adjustable	dBm	
OPTICAL RECEIVER			
20.	Nominal receive signal strength:	dBm	
21.	Receiver Threshold BER 10-6: BER 10-9:	dBm	
22.	Receiver overload limit:	dBm	
23.	Spectral Bandwidth (3 Db point):	Nm	
24.	Digital Bandwidth:	Mbps	
25.	Signal-to-noise @ center wavelength: @ 3 dB points:		
26.	AGC range:		
SERVICE CHANNELS AND ORDER WIRE UNIT			
Engineering Orderwire			
27.	Omnibus calling available Describe:	Yes/No	
28.	Selected station calling available? Describe:	Yes/No	
29.	Signalling scheme Describe:		
30.	Tx/Rx level	dBm	
31.	Speech coding method & bit rate	Kbit/s	
32.	Distortion: Noise performance:	S/N	
PROTECTION SWITCHING			
Seq.	Parameter:	Unit:	Particulars:
33.	Switching modes available Auto? Manual? Remote/network management?	Yes/No	
Date: Place: Seal: - continued- Signature: Name: Designation:			

Seq.	Parameter:	Unit:	Particulars:
34.	Switching priority:		
35.	Tx switchover & switchback criteria:		
36.	Rx switchover & switchback criteria:		
Seq.	Parameter:	Unit:	Particulars:
37.	Inbuilt Mux (if applicable) switchover & switchback criteria:		
38.	Switch option mode & status indicators:		
PDH Multiplexer			
Voice channels			
39.	Are Service channel requirements specified met?	Yes/No	
40.	No. of VF Channels:	Ea	
41.	Pass band:	KHz	
42.	Subscriber side interface:		
43.	Input & Output level	dBm	
44.	Idle channel noise	dBmOp	
45.	Distortion:		
Data and Supervisory Channel			
46.	No of data channels:	Ea	
47.	Interfaces/Connectors:		
48.	Data rates:	Kbps	
49.	List ITU-T Standards in compliance With:		
50.	Tributary bit rate (nominal):	Mbit/s	
51.	Tolerance in bit rate:	Ppm	
52.	Line code:		
53.	No. of ports:		
Date: Place: Seal: - continued- Signature: Name: Designation:			

Seq.	Parameter:	Unit:	Particulars:
54.	Impedance of coax cable used for Input/Output port:	ohms	
55.	Type of Connector		
56.	Spare cable pairs?		
57.	Input jitter acceptance 100 Hz to 10 KHz: 10 KHz to 800 KHz:	UI (p-p)	
58.	Maximum output jitter in the absence of i/p jitter 100 Hz to 10 KHz: 10KHz to 800 KHz:	UI (p-p)	
59.	Jitter transfer characteristic:		
OUTPUT PORT			
60.	Line impedance Balanced: Unbalanced:	Ω	
61.	Test load impedance (Unbalanced):	Ω	
62.	Peak pulse amplitude (nominal $\pm$ tolerance):	V dc	
63.	Pulse width (nominal $\pm$ tolerance):	ns	
64.	Ratio of +ve & -ve pulses at the center of a pulse interval		
65.	Ratio of width of +ive & -ive pulses at nominal half Amplitude		
66.	Maximum insertion loss	dB	
INPUT PORT			
67.	Attenuation Char. of inter-connecting cable for digital signal presented at input port		
68.	Return loss (at 1.024 MHz)	dB	
69.	Admissible i/p signal attenuation	dB	
70.	Cable loss Equalization Range	dB	
71.	Maximum insertion loss	dB	
72.	Electromagnetic compatibility(List standards & severity levels)		
Date:	- continued-	Signature:	
Place:		Name:	
Seal:		Designation:	

Seq.	Parameter:	Unit:	Particulars:
MECHANICAL AND ENVIRONMENTAL PARAMETERS			
73.	Number of chassis (including. DC/DC converters, O/W muldem etc.,) required for Unprotected Terminal: I: 1 Protected Terminal		
74.	Chassis Dimensions (L *W*H):	Cm	
75.	Chassis Weight:	Kg	
76.	Chassis mounting options:		
77.	Chassis clearance requirements Top * Bottom * Sides: Front Access: Rear Access:	M	
78.	Chassis colour and finish		
79.	Rack options available 19" ETSI? Slim rack? Others (specify)?	Yes/No Yes/No Yes/No	
80.	Protection Class (IP Class):		
81.	Rack Colour and Finish:		
82.	Temperature range Guaranteed performance: Operation without damage: Storage/ transport:	°C	
83.	Relative humidity Minimum: Maximum:	%	
84.	Altitude Installed: Transport/storage:	M	
85.	Describe Ventilation requirements:		
86.	Describe dust proofing provisions:		

Date:
Place:
Seal:

Signature:
Name:
Designation:

GUARANTEED TECHNICAL PARTICULARS for
OPTICAL LINE TERMINATION EQUIPMENT (SDH)
POWER SUPPLY UNIT (DC/DC CONVERTER)

Manufacturer:

Model #:

Seq.	Parameter	Unit:	Particulars:
1.	Nominal supply voltage:	Vdc	
2.	Power supply variation Guaranteed performance: Operation without damage:	Vdc	
3.	Polarity:	$\pm$	
4.	Whether 220 Vac mains operation Capability inbuilt		
5.	List derived DC voltages:	V dc	
6.	Total power consumption (Fully equipped incl. Service channels) Unprotected terminal: 1+1 Protected terminal:	Watt	
7.	1+1 APS protection provided?	Yes/No	
8.	MTBF of Power supply unit:	Hours	
9.	Ultimate Power delivery capacity	Watt	
10.	Are the following protections Provided Over voltage? Under voltage? Overload? Reverse polarity? Other(specify)?	Yes	

Date:

Signature

Place:

Name

Seal

Designation

GUARANTEED TECHNICAL PARTICULARS for Optical amplifiers

Seq.	Parameter	Unit:	Particulars:
GENERAL PARAMETERS:			
1.	Type of amplifier		
2.	Source Power supply requirements Volt: Current:		
3.	Gain medium		
4.	Small signal gain		
5.	Connection loss to transmission fibre	dB	
6.	Insertion loss	dB	
7.	System noise figure		
8.	Type of pump – Laser		
9.	Pumping wavelength		
10.	Bit-rate Distance Product		
11.	Type of Optical coupler		
12.	Type of Optical isolator		
13.	Operating optical bandwidth		
14.	Polarisation gain dependant		
15.	Can the same optical amplifier operate at: STM-1 ? STM-4 ? STM-16 ?	Yes/No.	
16.	Operating bit-rate Lower limit: Upper limit:		

17.	“ F “ type interface ?	Yes/No	
18.	Optical input: Signal wavelength: Signal input power (max.): Signal input power (min.): Spectral width (-20 dB from peak): Connector type: Pulse shape: Optical reflectance:		
19.	Optical output: Signal output power (max.): Signal output power (min.): Connector type:		
20.	List & describe Monitor, control & Alarm points:		
21.	Alarm contact		
	Alarm output		
	Describe Network Management interface provisions: F & Qx		

Date:

Signature

Place:

Name

Seal

Designation

GUARANTEED TECHNICAL PARTICULARS for INSIDE PLANT EQUIPMENT and MATERIALS - DIGITAL DISTRIBUTION FRAMES

Manufacturer:

Model Name & #:

Seq.	Parameter:	Units:	Particulars
1.	Dimensions Height: Width: Depth:	cm cm cm	
2.	Weight:	Kg	
3.	Colour and Finish:		
4.	Method(s) of Mounting		
5.	Clearances required for Installation: From Ceiling: From Rear:	mtr mtr	
6.	Cable entry (s):		
7.	Cable Glanding:		
8.	Frame material & Guage:		
9.	Locking Arrangement		
10.	Frame capacity: (No. of co-axial panels)	Each	
11.	Co-axial panel capacity: (Number of PCM Systems)	Each	
12.	Co-axial connectors: Type: Characteristic impedance: Return loss (up to 90 MHz): Transfer impedance: Test voltage (1 Minute): Maximum current rating:	Ω dB Ω V A	

13. Provide details on installation, cabling, cross connections and patching facilities (if any).

Date:

Signature:

Place:

Name:

Seal:

Designation

GUARANTEED TECHNICAL PARTICULARS for INSIDE PLANT EQUIPMENT and MATERIALS - MAIN DISTRIBUTION FRAMES

Manufacturer:

Model Name & #:

Seq.	Parameter:	Units:	Particulars
1.	Dimensions Height: Width: Depth:	cm cm cm	
2.	Weight:	Kg	
3.	Colour and Finish:		
4.	Method(s) of Mounting		
5.	Clearances required for Installation: From Ceiling: From Rear:	mtr mtr	
6.	Cable entry (s):		
7.	Cable Glanding:		
8.	Frame material & Guage:		
9.	Locking Arrangement		
10.	Frame capacity: Number of horizontal rows: Number of vertical rows: No. of terminal blocks per row:	Each	

13. Provide details on installation, cabling, cross connections and patching facilities (if any).

Date:

Signature:

Place:

Name:

Seal:

Designation

SECTION – 3

PROJECT INFORMATION AND GENERAL TECHNICAL REQUIREMENTS

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CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).
The nearest Railway station is at Ashipattu Pudunagar (approx 5 kms)
All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.
The nearest airport is at Chennai at a distance of 60 km.

1.3 NA

1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

LOCATION

The site is located near Vayalur Village, Ennore

Latitude : 13°17' N to 13°18' N

Longitude : 80°18' E to 80°19' E

Distance from Chennai City : 35 km

Nearest Airport is at Chennai at a

Distance of : 60 km

Nearest Seaport is : Ennore

Nearest Railway Station is : Athipattu Pudunagar (approx 5 kms)

Meteorological Condition

Climate : Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data	:		
Ambient temp. (°C)	:	Annual Maximum Mean Temp	41.5(°C)
	:	Annual Minimum Mean Temp	24(°C)
	:	Design Ambient temperature	50(°C)
Relative Humidity	:	Maximum 100% Minimum 36% Design 75%	
Annual Rainfall	:	Maximum 2540 mm Average 1600 mm Minimum 1175 mm	
Prevailing Wind Direction	:	Nov to Jan – From NW & NE Feb to Mar – From East & SE Apr to May – From South & SE June – From SW July to Aug – From NW Sept to Oct – From SE & SW Wind Speed 11.8 kmph (avg) 50 kmph (max)	

Seismic Zone	:	Seismic Zone III as per IS:1893-2002 minimum 0.16 g horizontal	
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1.5

1.7

Access to Site

Site is well connected to all weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

CHAPTER – 2

GENERAL TECHNICAL REQUIREMENTS

1.00.00 ELECTRICAL SYSTEM PARTICULARS

1) Standard voltage levels

The standardized voltage levels as shall be adopted as specified elsewhere in this specification.

2) Permissible variations:

The system unit/plant equipment shall be designed suitable for continuous operation with variation in voltage and frequency as indicated below:

3) Variation in voltage and frequency

	Voltage	Frequency
Permissible variation for power supply with rated Performance /rated current and control effectiveness maintained	+/- 10%	-5% to +3%
Permissible variation for control and regulation equipment with rated Performance and control quality maintained		

4) Basic insulation levels

Equipment shall be designed suitable for basic insulation levels as given below:

Nominal Voltage (kV)	BIL kV (peak)
400 kV	1425
33 kV	170
11 kV	75
3.3 kV	40

5) Symmetrical short circuit ratings

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels shall be as indicated in the Table below:

S. No.	Voltage level	Symmetrical Breaking Capacity	Making Capacity
1.	400 kV	63 kA for 1 sec	163 kA
2.	33 kV	25 kA for 3 sec	62.5 kA
3.	11 kV	50 kA for 3 sec	125 kA
4.	3.3 kV	40 kA for 3 sec	100 kA
5.	415 V	50 kA for 1 sec	125 kA
6.	220 V DC	25 kA for 1 sec	-
7.	48 V DC	10 kA for 1 sec	

6) Criteria for selection of voltage levels for motors

Sr. No	Rating	Voltage Level
1	LV Motors- Up to 160 kW	415 V, 3 phase, 50 Hz
2	MV Motors- More than 160 kW and up to 1500 kW	3.3 kV, 3 phase, 50 Hz
3	HV Motors- Above 1500 kW	11 kV, 3 phase, 50 Hz

7) System Earthing

- i. 33kV/11 kV and 3.3 kV : Resistance grounded.
- ii. 415 V : Solidly grounded.

8) Degree of Protection:

Degree of protection for various electrical equipment shall be as follows:

S.No.	Equipment	Degree of Protection
1.	Marshalling Boxes, Panels, Motors located outdoor	IP55
2.	Electrical Equipment of CH System	IP55 with dust proof enclosure
3.	HV Switchgear	IP-4X for bus bar chamber, IP-6X for other compartments
4.	LV Switchgear	IP52 up to 1600 A and IP42 above 1600 A

2.00.00 GENERAL TECHNICAL PARTICULARS FOR EHV SYSTEM

(a)	Rated voltage	400 kV
(b)	Rated frequency	50 Hz
(c)	Rated short time current withstand capacity	63 kA rms for one (1) second
(d)	Rated one minute power frequency withstand voltage	650 kV rms between live terminals and earth b) 815 kV rms across isolating distance
(e)	Rated lightning impulse withstand voltage	a) 1425 kVp between live terminals b) 1425 (+240) kVp across isolating distance & earth.
(f)	Rated Switching Impulse withstand voltage	a) 1575 kVp (between phases) b) 900 (+345) (across isolating distance)
(g)	Phase to phase spacing	4000 mm
(h)	Rated terminal load	Adequate to withstand 100 kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.
(i)	System neutral earthing	Effectively earthed
(j)	Support structure height	Adequate so that lowest part of support insulator of equipment is 2550 mm (minimum) from ground and/or plinth level.
(k)	Creepage distance	Minimum 31 mm / kV
(l)	Electrical Clearances	

Clearances shall be as given below and as per relevant statutory rules/codes.		
1.	Phase to earth	3500 mm
2.	Phase to phase	4000 mm
3.	Sectional clearance	6500 mm
4.	Ground clearance	8000 mm

3.00.00 NA

4.00.00 COMPLETENESS

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 CODES & STANDARDS

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

- (a.) Bureau of Indian Standards (BIS)
- (b.) Indian electricity act
- (c.) Indian electricity rules
- (d.) Indian Explosives Act

- (e.) Indian Factories Act and State Factories Act
- (f.) Indian Boiler Regulations (IBR)
- (g.) Regulations of the Central Pollution Control Board, India
- (h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- (i.) Pollution Control Regulations of Department of Environment, Government of India
- (j.) State Pollution Control Board.
- (k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- (a.) Japanese Industrial Standards (JIS)
- (b.) American National Standards Institute (ANSI)
- (c.) American Society of Testing and Materials (ASTM)
- (d.) American Society of Mechanical Engineers (ASME)
- (e.) American Petroleum Institute (API)
- (f.) Standards of the Hydraulic Institute, U.S.A.
- (g.) International Organisation for Standardization (ISO)
- (h.) Tubular Exchanger Manufacturer's Association (TEMA)
- (i.) American Welding Society (AWS)
- (j.) National Electrical Manufacturers Association (NEMA)
- (k.) National Fire Protection Association (NFPA)
- (l.) International Electro-Technical Commission (IEC)
- (m.) Expansion Joint Manufacturers Association (EJMA)
- (n.) Heat Exchange Institute (HEI)

5.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else

where in the specification together with the complete word to word translation of the standard that is normally not published in English.

~~5.04.00~~ NA

5.05.00 NA

5.06.00 NA

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling.

7.02.00 Maintenance and Availability Considerations

Equipment offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely the minor and major overhauls shall be specified in maintenance manuals, clearly defining the spare parts and man-hour requirement for each stage.

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

- 8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Chapter 4.
- 8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Equipment Definition Manual within 4-6 weeks from the date of the Purchase Order. This manual shall contain the following as a minimum:

- i. System description of all the mechanical, electrical, control & civil systems.
- ii. Technology scan for each system / sub-system & equipment.
- iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- iv. NA.
- v. Sizing criteria of all the systems, sub-systems including various equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- vii. Operation Philosophy and the control philosophy.
- viii. General Layout plan.
- ix. NA
- x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xi. NA
- xii. NA
- i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
- ii. NA

- iii. NA
- iv. NA
- v. NA
- vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.
- vii. Detailed design calculations for components, system/sub-system, etc., wherever applicable including sizing calculations as per criteria specified elsewhere in specification.
- viii. NA
- ix. NA
- x. NA
- xi. NA
- xii. NA
- xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- xiv. NA
- xv. Interconnection diagrams.
- xvi. Cable routing plan.
- xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring diagrams of panels and enclosures etc.
- xviii. Alarm and annunciation list and alarms & trip set points.
- xix. Sequence and protection interlock schemes.
- xx. Type test reports
- xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.
- xxii. Detailed software manuals & source software listing.
- xxiii. Detailed flow chart for digital control system.
- xxiv. Mimic diagram layout.
- xxv. Civil Task drawings(for the Engineering by BHEL),Design and Drawings.
- xxvi. Model study reports wherever applicable.
- xxvii. NA
- xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

8.03.01 Instruction Manuals

The Bidder shall submit, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the BHEL / OWNER the Instruction Manuals shall be submitted as indicated in Chapter-4. **The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals with As Built drawings have been supplied.** The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipment like cranes, dozers, etc.
- f) Bill of Materials
- g) Procedure for erection.
- h) General safety procedures to followed during erection/installation.
- i) Procedure for initial checking after erection.
- j) Procedure for testing and acceptance norms.
- k) Procedure / Check list for pre-commissioning activities.
- l) Procedure / Check list for commissioning of the system.
- m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

- i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the BHEL / OWNER to operate, 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, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied.
- ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the BHEL / OWNER for records.
- iii. 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 and drawings.

- iv. 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.
 - c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.
- v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.
- vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the BHEL / OWNER indicating lubrication method for each type/category of bearing.

8.03.02

Plant Handbook

The Bidder shall submit to the BHEL / OWNER a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various equipment and systems covering the complete project including	
1.	Design and performance data.
2.	Process & Instrumentation diagrams.
3.	Single line diagrams.
4.	Sequence & Protection Interlock Schemes.
5.	Alarm and trip values.
6.	General layout plan
7.	Important Do's & Don't's
8.	The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of BHEL / OWNER's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03

Project Completion Report

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04

Drawings

- (a.) All documents submitted by the Bidder for BHEL / OWNER's review shall be in electronic form (soft copies) **along with the desired**

number of hard copies as per Chapter-4. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.

- (b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Chapter-4.
- (c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to BHEL / OWNER.
- (d.) All documents/text information shall be in latest version of MS Office.
- (e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- (f.) Each drawing submitted by the Bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the BHEL / OWNER, Consultant, name of the Project, system designation, the specifications title, the specification number, drawing/document number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- (g.) The Bidder shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the BHEL / OWNER. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- (h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.
- (i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy

of the information submitted. The review and/ or approval by the BHEL / OWNER / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.

- (j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the BHEL / OWNER.
- (k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder's risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the BHEL / OWNER. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such changes shall promptly be brought to the notice of the BHEL / OWNER indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.
- (l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of BHEL / OWNER prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of BHEL / OWNER based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.
- (m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.
- (n.) As Built Drawings

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

- (o.) 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 BHEL / 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 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 BHEL/OWNER's scope and submit all necessary drawings/ documents for the same.

- (p.) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The BHEL/OWNER shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.
- (q.) All engineering data submitted by the Bidder after final process including review and approval by the BHEL/OWNER shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the BHEL/OWNER in writing.

8.04.00 Engineering Information Submission Schedule

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the BHEL/OWNER. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- (a.) Information that shall be submitted for the approval of the BHEL/OWNER before proceeding further, and
- (b.) Information that would be submitted for BHEL/OWNER's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 Engineering Progress and Exception Report

8.05.01 Report giving the status of each engineering information including

- (a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- (b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the BHEL/OWNER within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the BHEL/OWNER.

8.06.00 Co-Ordination Meetings

8.06.01 The Bidder shall be called upon to attend monthly Design/ Co-ordination Meetings (if required) with the BHEL/OWNER/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the BHEL/OWNER as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the BHEL/OWNER shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.

8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.

8.07.00 Design Improvements

The BHEL/OWNER or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

8.08.00 NA

8.09.00 NA

8.10.00 Lubricants, Servo Fluids and Chemicals

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.11.00 NA

8.12.00 Material of Construction

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 Rating Plates, Name Plates & Labels

8.13.01 Each main and auxiliary item of plant including instruments 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 BHEL/OWNER.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the BHEL/OWNER or as detailed in appropriate section of the technical specifications.

8.13.03 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. The name plates shall be suitably fixed on both front and rear sides.

8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

8.13.06 Valves, steam traps and strainers shall be identified by BHEL/OWNER's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

- 8.13.07 Safety and relief valves shall be provided with the following :
- (a.) Manufacturer's identification.
 - (b.) Nominal inlet and outlet sizes in mm.
 - (c.) Set pressure in Kg/cm² (abs).
 - (d.) Blowdown and accumulation as percentage of set pressure.
 - (e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 8.13.08 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.
- 8.13.09 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

8.14.00 Tools and Tackles

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the BHEL/OWNER.

8.15.00 Welding

- 8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed by others the requirements shall be submitted to the BHEL/OWNER in advance of commencement of erection work.

8.16.00 Colour Code for all Equipment/ Pipings/ Pipe Services

- 8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with BHEL/OWNER's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 Protection and Preservative Shop Coating

8.17.01 Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 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 atleast 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 colors shall be as per manufacturer's standards, to be selected and specified by the BHEL/OWNER at a later date.

8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the BHEL/OWNER 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 Owner.

8.17.04 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.

8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

- (a.) His organization structure for the management and implementation of the proposed quality assurance programme
- (b.) Quality System Manual
- (c.) Design Control System
- (d.) Documentation and Data Control System
- (e.) Qualification data for bidder's key personnel.
- (f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- (h.) Control of non-conforming items and system for corrective actions and resolution of deviations.
- (i.) Inspection and test procedure both for manufacture and field activities.
- (j.) Control of calibration and testing of measuring testing equipment.
- (k.) System for Quality Audits.
- (l.) System for identification and appraisal of inspection status.
- (m.) System for authorising release of manufactured product to the Owner.
- (n.) System for handling, storage and delivery.
- (o.) System for maintenance of records, and
- (p.) 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.

9.02.00 General Requirements - Quality Assurance

9.02.01 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 Bidder 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 Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.

- 9.02.02 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 Bidder's/ Sub-Bidder'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. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- 9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 9.02.04 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 Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.
- 9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 9.02.06 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.
- 9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the format No.: QS-01-QAI-P-02/F3 to be issued at contract stage.
- 9.02.08 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 Owner.

All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.

- 9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder'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 Owner.
- 9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.
- 9.02.11 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 equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 9.02.13 No welding shall be carried out on cast iron components for repair.
- 9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

- 9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder 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 Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder'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 sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

- 9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.
- 9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- 9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment 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.
- 9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner 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 Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.
- 9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment
- All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

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

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

Burn in Test Cycle

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

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

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

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

9.03.00 QA Documentation Package

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

- 9.03.01 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 despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

- (a.) Quality Plan

- (b.) Material mill test reports on components as specified by the specification and approved Quality Plans.
- (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- (d.) 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.
- (e.) Heat Treatment Certificate/Record (Time- temperature Chart)
- (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- (g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.
- (h.) Certificate of Conformance (COC) wherever applicable.
- (i.) MDCC

9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.04 Before despatch / 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.

- (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- (c.) If a decision is made despatch, 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 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 despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 Project Manager's Supervision

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Owner's Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

- (a.) Interpretation of all the terms and conditions of these documents and specifications:
- (b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:
- (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :
- (d.) Inspect, accept or reject any equipment, material and work under the contract.
- (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates
- (f.) Review and suggest modifications and improvement in completion schedules from time to time, and
- (g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 Inspection, Testing And Inspection Certificates

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

- 9.05.02 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner 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 Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, 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 Bidder 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.
- 9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, 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 Bidder 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.
- 9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder'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 Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, 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 authorized representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.
- 9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

- 9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder 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.
- 9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
- 9.06.00 **Associated document for quality assurance programme:**
- 9.06.01 List of items requiring quality plan and sub supplier approval.
- 9.06.02 Status of items requiring Quality Plan and sub supplier approval.
- 9.06.03 Field Welding Schedule
- 9.06.04 Manufacturing Quality Plan
- 9.06.05 Field Quality Plan
- Format for the above shall be issued at Contract stage.

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

- (a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- (b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be

furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

- (c.) NA
- (d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.
- (f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.
- (g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :
 - (1.) Biodata including experience of the Commissioning Engineers.
 - (2.) Role and responsibilities of the Commissioning Organisation members.
 - (3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 Initial Operation

- a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.
- b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation

- of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.
- c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.
 - d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.
 - e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.
 - f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

10.03.00 **Guarantee Tests**

- a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule.
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.
- c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.
- d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.
- e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

- 12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

- (a.) Training for Electric Power Supply systems

The above training shall be provided taken by the Bidder in one of the reference power plant.

- 12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 2 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-I (BOQ).
- 12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 1 and 2 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.
- 12.04.00 Refer Annexure-II for detailed scope of services under Training.
- 12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.
- 12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- (a.) Working platforms should be fenced and shall have means of access.
- (b.) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

14.00.00 NA

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

- Manufacturer shall furnish detailed Packing list before dispatch of material
- Master Packing List for complete list of Equipment or Material to be furnished to BHEL for this project during detailed Engineering Stage.

The Packed item shall have Marking Plate with following details on Packing:

	BHEL-TBG-Noida-India
NAME OF ITEM	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	
DESPATCH ADVICE NOTE NO.	
DIMENSIONS (MM) LXBXH	
NET WEIGHT (KG)	
GROSS WEIGHT (KG)	
SPECIAL INSTRUCTIONS	HANDLE WITH CARE – KEEP DRY DO NOT DROP – DO NOT TILT (or manufacturer's instructions)
MO. NO.	
CASE NO.	

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm ²). Pressure instrument shall have the unit

			suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
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17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 NA

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

- (a.) Temperature test pockets with stub and thermowell
- (b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.

CHAPTER - 3

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austentic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)

IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- (i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and

final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

- (ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.
- (iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- (iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- (v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m².

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

CHAPTER 4

DRAWING DOCUMENT SUBMISSION

4.1 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/CUSTOMER for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/CUSTOMER shall be final and binding on the Supplier.

4.2 APPROVAL PROCEDURE

The scheduled dates for the submission of drawings as well as for, any data/information to be furnished by the Employer would be as per the following schedule. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	First Submission	Within 7 days from the date of LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed sheet for details of Title block.

4.3 TITLE BLOCK

Following Title Blocks to be used in drawings at the time of drawing approvals

Project:	400kV GIS at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS, Chennai-120		
NOA No:	CE/P/SE/M/P/EE-10/E/P/F.2X660MW	ENNORE	SEZ
	STTP/D60/DT 27.027.2014		
Customer :	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)		
Consultant	DESEIN PRIVATE LIMITED, NEW DELHI		
Contractor	BHARAT HEAVY ELECTRICALS LIMITED		

4.4 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) List of Part Supplies with rating

Drawings & Documents submitted at the time of offer shall be subject to review at contract stage.

4.5 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Hard Copy / Prints	Hard Copy / Prints	CDs
1	Drawings and Data Sheets	1	7	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	7	10	
4	Erection Manuals	-	7	10	
5	Operation and Maintenance Manuals	-	7	10	
6	Manufacturing Quality Plan	-	7	10	
7	Field Quality Plan	-	7	10	

8	Inspection Test Reports	-	7	10	
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Supplier to submit Hard copies of the drawing to following address

To,
<Name of BHEL's concerned engineering official>
Bharat Heavy Electricals Limited
Transmission Business Group- Engineering Management
Advant Navis IT Business Park
Plot No.-7, Greater Noida Expressway,
Sector 142, **NOIDA**, Uttar Pradesh 201305

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD version or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with details of Customer & Project etc. written on top.

Project: 400kV GIS at 2x660MW Ennore SEZ Bharat Heavy Electricals Limited
Customer: Tamil Nadu Generation and Distribution Corporation
Doc. No: TB-378-510-022 Rev00
Technical Specification: Fibre Optic Telecommunication System

SECTION 5

CHECKLIST FOR TECHNICAL EVALUATION

Along with the Technical Bids of the offers, the Bidder should submit this checklist confirming the inclusion of the enclosures as listed below. (Shall tick as ✓)

Sr No	Documents to be enclosed	Bidder to check & confirm
1	Copy of Unpriced BOQ as enclosed in the Technical Specification to confirm that bidder has quoted in the same format	
2.	Schedule of Technical Deviation format duly signed	
3.	Duly filled and signed format of Technical requirement of PQR (Annexure to Section -5) along with supporting documents mentioned therein.	

NOTE:- If the Bidder fails to submit any of the documents as asked in the above check list, their bid is likely to be rejected / not evaluated.

The above checklist is verified for:-

NIT Ref No. :

Name of Equipment :

Name of Project :

Name of Bidder :

Signed with Seal of Bidder

Date

TECHNICAL REQUIREMENT OF PQR

Name of Project:- 400kV GIS at 2x660MW Ennore SEZ

Name Of Item :-Fibre Optic Telecommunication System

Doc. No: TB-378-510-022 Rev00

Sr. No	Description	Supporting Document to be attached								Reference No. of supporting documents																
A)	Cl. No. 1.3 of Section-1 of TS (Annexure-D)																									
01	The bidder should have designed, tested, supplied and commissioned OLTE equipments for 400kV system or above to Electricity boards/ Power utilities in India during the last Ten (10) years and the same should have been in satisfactory operation(#) for a minimum period of Two years as on date of of techno-commercial bid opening of this tender. (#) Satisfactory operation means certificate issued by the Customer certifying the operation without any adverse remark.	a) Bidder to provide confirmation of fulfilling Technical Requirements mentioned in Cl. No. 1.3 of Section-1 of TS. b) Purchase Orders The details are to be submitted in following format, <table><tr><th>Sr. No</th><th>ITEMS SUPPLIED TO</th><th>ORDER REFERENCE No. & DATE</th><th>ITEMS</th><th>QUANTITY</th><th>ORDER FULLY EXECUTED. YES/NO</th><th>STATUS, IF ORDER UNDER EXECUTION</th><th>REMARK</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> c) Dispatch Instructions/ Material Receipt at site certificate/ Lorry Receipt details etc d) Letter/ Certificate/ MOM from customer/ end user for satisfactory operation								Sr. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED. YES/NO	STATUS, IF ORDER UNDER EXECUTION	REMARK									a) b) c) d)
Sr. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED. YES/NO	STATUS, IF ORDER UNDER EXECUTION	REMARK																			