



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

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				GROUP	TBEM		
				W.O. No	84007		
CUSTOMER	Tamil Nadu Generation and Distribution Corporation						
PROJECT	400kV GIS at 2x660MW Ennore SEZ						

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Rev.	Date	Altered	Checked	Approved	REVISION DETAILS
Distribution			CUSTOMER	TBMM	O/C
			-		

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 Hybrid FOTE(SDH & MPLS-TP) equipment and integrated PDH Multiplexers with cross connect and with standalone Digital Protection couplers (8 command) & with integrating with NMS , termination equipment & Telecommunication Management Network (TMN) complete with accessories as listed under this specification.

This section covers the specific technical requirements of Hybrid FOTE (SDH & MPLS-TP) 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 Hybrid FOTE equipment & other communication accessories required for integration of 400kV Ennore station is furnished in the enclosed BOQ.

1.2.3 The scope includes integration of the proposed hybrid FOTE equipments in the above Project with the existing communication equipments / newly proposed equipments at the remote end stations.

- 1.2.4 The scope includes supply of entire accessories such as SFPs (including remote ends), connecting cables, patch chords, LIUs etc, needed for the integration of FOTE and multiplexer with remote end equipments. The price of same shall be included in the quoted price.
- 1.2.5 The scope includes integration of 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 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 the scope of supply.
- 1.2.7 Proposed SFPs shall be compatible for all types of Hybrid FOTE 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 FOTE/ 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 present scope for this tender. Necessary co-ordination, modification and interfacing with remote end existing equipments as applicable shall be in present 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 present scope.
- 1.2.15 All SFP's shall be suitable for mounting in the SDH cabinets being offered.
- 1.2.16 The overall contract value may vary by +/- 20%.

1.3 TECHNICAL QUALIFYING REQUIREMENTS:

Please refer Annexure-D

1.4 TYPE TEST REQUIREMENTS

The manufacturer must submit type test reports for SDH, PDH Multiplexer and Interface for Protection inter-trip or Digital Protection coupler as per IS/IEC/EIA or any other equivalent standard, obtained from an independent test laboratory or if the tests have been carried out in their in-house laboratories, the same should have been witnessed by the representative of any reputed inspecting agency. The test should have been conducted within five (5) years prior to date of supply. All necessary type test report shall be furnished along with the bid. Otherwise the offer is liable for rejection.

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 DRAWING APPROVAL:

The successful bidder shall have to extend all possible support like timely submission/re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end

customer's approval. Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings.

Approval of the following drawings will be required for technical clearance of manufacturing for FOTE equipment along with accessories.

- Transmission Network Configuration Drawing
- Cabinet Layout Drawing
- GTP
- Bill of materials
- Optical link budget calculations

1.11 ENCLOSURES TO SECTION -1

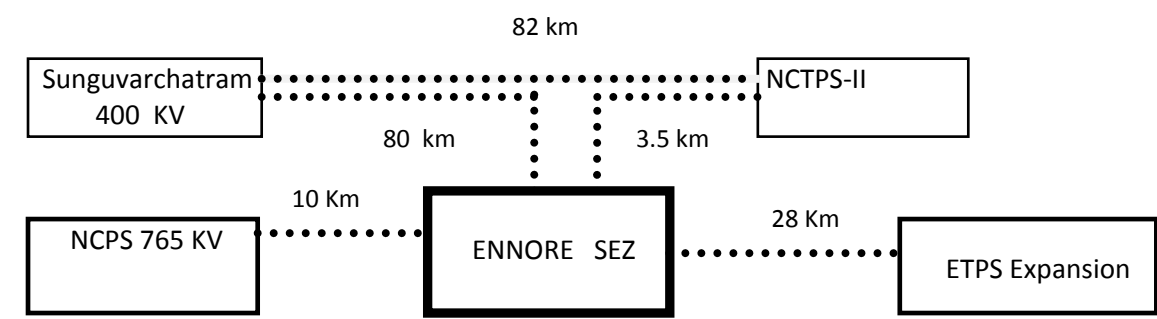
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|----|------------|--|
| 1) | ANNEXURE-A | : BOQ OF FOTE |
| 2) | ANNEXURE-B | : Existing F.O Network & Proposed stations. |
| 3) | ANNEXURE-C | : Details of equipment in adjacent stations to the proposed station. |
| 4) | ANNEXURE-D | : Technical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

TANGEDCO ENNORE OLTE EQUIPMENT BOQ			
Sl. No.	Item Description	Unit	Quantity
			TOTAL
1	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Hybrid FOTE (SDH & MPLS-TP) equipments with integrated PDH multiplexers suitable for 6 directions (MSP) & 1G/10G MPLS-TP port, 04 directions with MSP (STM-4/ STM-16)(STM-4 upgradable to 16) and 02 directions with MSP (STM-4/STM-1) ports are required with main & standby complete in all respect as per technical specification.	Set	2
2	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: PDH Multiplexer with cross-connect for 16 E1 ports	Nos.	2
3	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Ethernet SFPs (1G SFP+ suitable for MPLS-TP traffic, MSA 2000 compliant)	Nos.	10
4	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Ethernet SFPs (10 G SFP+ suitable for MPLS-TP traffic, MSA 2000 compliant)	Nos.	6
5	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: L4.2x SFP/ Optical Interface Card for 100 km	Nos.	6
6	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: 10/100/1000Mb Layer 2 type 4 port Ethernet module -1no. & 10G layer 2 type 4 port ethernet module- 1no.	Set	2
7	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: 4 port Differential protection card, compatible with C37.94 standard,8 directions	Nos.	4
8	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: 4 port Differential protection card, compatible with C37.94 standard (if OLTE equipment supplied from M/s ABB) or 4 port Differential protection card, compatible with C37.94 standard along with multiplexers (if OLTE equipment supplied by other vendors) , 2 directions & has to be interfaced with ABB make FOX 615 OLTE at Remote end	Nos.	6
9	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: 8 command stand alone Digital Protection coupler , medium shall be G.703,co-directional with E1 electrical & optical interface (Output port shall be suitable for Both SDH & MPLS-TP traffic)	Nos.	14
10	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Patch Cord of 20m length (suitable type as per site requirement	Nos.	50
11	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Hybrid EPAX with Analog/VOIP/Digital/PLCC interface Cards (each card with 16 subscriber & 50 trunks & spare modules	Set	1
12	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: 4 pair Telephone cable (0.6mm)	kM	4
13	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Telephone	Nos.	6
14	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: VOIP Phone	Nos.	16
15.1	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Line interface card for S4.1 SFP MSA 2000 compliant	Nos.	8
15.2	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Line interface card for L4.2 SFP MSA 2000 compliant	Nos.	4
15.3	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Line interface card for L4.2x SFP MSA 2000 compliant	Nos.	2
15.4	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Line interface card for S 16.2 SFP	Nos.	10
15.5	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Optical Line interface card for L 16.2 SFP	Nos.	10
16	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: EMS/NMS for OLTE & Multiplexers (Including laptops,workstations,application softwares, licenses etc. as per TS)	Set	1
17	Mandatory Spares		
17.1	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM:20% of the total BOM quantity of each type of SFP (Fraction rounded to next higher number)	Lot	1
17.2	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM:20% of the total BOM quantity of each type of Sub-rack (Fraction rounded to next higher number)	Lot	1

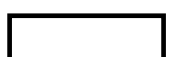
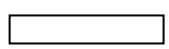
17.3	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM:20% of the total BOM quantity of each type of modules including SDH modules,PDH modules,power supply modules, alarm modules etc. along with connectors,cables,tag blocks etc. (Fraction rounded to next higher number)	Lot	1
17.4	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM: Connectors for DDF connectivity	Nos.	25
17.5	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM: Baluns (75 Ohms to 120 Ohms) for DDF connectivity	Nos.	25
17.6	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM: Co-axial cable for DDF connectivity	kM	0.5
17.7	SPARES - FIBRE OPTIC COMMUNICATION SYSTEM: Optical patch chords of 20 mtr length with suitable connectors at both ends	Nos.	90
17.8	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Tools & Tackles:Crimping tools suitable for crimping the connectors and cables supplied	Set	3
17.9	SUPPLY - FIBRE OPTIC COMMUNICATION SYSTEM: Surge protection devices for supplied OLTE, Multiplexer & Digital protection coupler	Set	6
18	Services		
18.1	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM: Training for 6 (Six) No. of Customer Engineers on SDH, PDH Multiplexers and interface for differential protection/ protection inter-trip (as per clause 38 of Section-II) for a duration of 5 (Five) days at Manufacturer works.	Lot	1
18.2	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM: Lodging and boarding Charges for 6 (Six) Nos. of Customer Engineers for a duration of 5 (Five) days at manufacturer works.	Lot	1
18.3	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM : To and Fro charges of 6 (Six) Nos. of Customer Engineers for the Training at manufacturer works.	Lot	1
18.4	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM: Splicing of Fibres at Both ends of Link,including splicing at respective FODPs. (Link Wise)	Lot	4
18.5	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM: a) Support services as per clause 34 of Section-II of TS, b) Services for SAT (As per clause 30 of Section-II of TS) , GSAT (As per clause 30.1.2 to 30.2 of Section-II of TS) and Commissioning of Telecommunication system including Supervision of Installation (Link Wise)	Lot	4
18.6	SERVICES - FIBRE OPTIC COMMUNICATION SYSTEM: Maintenance & Technical support services (as per clauses 31,32,33,34,35 & 36 of Section-II o f TS)	Lot	1

ANNEXURE-B : Existing F.O Network & Proposed stations.

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



.....

-  Newly proposed stations
-  Existing stations
-  Ennore SEZ station

DETAILS OF EQUIPMENT IN ADJACENT STATIONS TO THE PROPOSED STATION

Name of the station	Adjacent station	Eqpt. In adjacent station
Ennore SEZ 400 KV	NCPS 765 KV	Fox 615
	NCTPS stage-II	Fox 615
	Ennore Expansion	Fox 615
	Sunguvarchatram 400 KV SS	Fox 615

Schedule A:

Sl. No.	Name of the station	Quantity required			4 port, 1G MPLS-TP optical/electrical cards.	Digital protection couplers (8 command)	No. of SDH/MPLS -TP links to be connected	Differential protection interface cards with C 37.93 compatibility
		4 port, STM-4/16 SDH optical cards	Integrated PDH Multiplexer with Cross-Connect	4 port, 10G MPLS-TP optical cards				
1.	Ennore SEZ	6 Nos.	2 Nos.	2 nos.	2 nos.	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.		--

TECHNICAL QUALIFYING REQUIREMENT

ANNEXURE-D

Bidder should be manufacturer or its authorized representative of the offered Synchronous Digital Hierarchy (SDH) Equipments and Plesio-synchronous Digital Hierarchy (PDH) Multiplexers. The offered Synchronous Digital Hierarchy (SDH) Equipments and Plesio-synchronous Digital Hierarchy (PDH) Multiplexers are to be successfully tested (as applicable IS / IEC or equivalent standard) as on scheduled date of technical bid opening of this tender.

The manufacturer whose SDH Equipments and PDH Multiplexers are offered (or its earlier version), must have designed, manufactured & supplied at least 5 Nos. of OLTE / FOTE & 5 Nos. of Multiplexers during the last five years prior to the scheduled date of technical bid opening of this tender.

And if the bidder is not manufacturer of offered SDH & PDH or its earlier version, should have supplied, erected, tested and commissioned OLTE / FOTE & Multiplexers during the last five years prior to the scheduled date of technical bid opening of this tender.

Remark:

1. Necessary P.O. copies in respect of OLTE / FOTE, SDH equipment and PDH Multiplexer in their name shall be submitted along with the bid.
2. If the bidder is not the manufacturer of offered SDH & PDH, Necessary documentary evidence for being the authorized representative of manufacturer shall be enclosed.

TECHNICAL SPECIFICATION FOR HYBRID FOTE EQUIPMENT & DIGITAL PROTECTION COUPLER

SECTION-2

1.0 INTRODUCTION

1.1 GENERAL:

TANTRANSCO intends to establish Fibre Optic Communication links, through Optical fibres between the locations given below and Hybrid FOTE (SDH& MPLS-TP) equipments and integrated 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.	Proposed substation	Other end substations	
2.	Ennore SEZ 400 kV SS	ETPS Expansion 400 kV SS	28
3.	Ennore SEZ 400 kV SS	NCPS 765 KV	10
4.	Ennore SEZ 400 kV SS	NCTPS stage-II	3.5
5.	Ennore SEZ 400 kV SS	Sunguvarchatram 400 kV SS	82

The requirement of SDH cards, PDH cards, MPLS-TP cards, SFPs, Ethernet modules etc., 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:

- Design, engineering, manufacture, transport, installation , testing and commissioning of Hybrid FOTE (SDH & MPLS-TP) equipments and integrated PDH Multiplexers with Cross connect & with standalone Digital Protection couplers (8 command) & integrating with NMS.
- integrating the new F.O. links with the existing F.O. network.
- Integrating the proposed FOTE equipments with the other end existing & proposed Hybrid FOTE equipments (SDH & MPLS-TP).
- Provision of an efficient Element Management System licensed to accommodate atleast 100 Network Elements and capable to accommodate atleast 500 Network Elements.
- All cabling, wiring, patch facilities, equipment DDF's and interconnections to the supplied equipment side of the defined interfaces.
- Supply of testing instruments & mandatory spares as per site requirement.

3.0 **EXISTING COMMUNICATION FACILITIES:**

Details of Existing FOTE equipments in adjacent stations to the proposed stations are shown in Appendix-II.

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

4.0 GENERAL REQUIREMENTS

4.1 Introduction

The proposed equipment shall be designed to operate in electrical high-voltage networks and suitable for installations in substations with harsh environment and high electromagnetic interference. It shall be highly reliable and provide secure communication. The hybrid equipment shall offer the possibility of fan less operation

in order to ensure for maintenance free operation and comply with the environmental conditions in substation environment. Accordingly, it shall comply with substation relevant standards such as IEEE 1613/IEC 61850-3. **The equipment offered shall comply with the latest ITU-T and IETF recommendations, ETSI and IEEE standards and be able to be interconnected with legacy multiplexed signals. On PACKET TRANSPORT LEVEL interfaces for optical MPLS-TP based transmission up to 10Gbit/s shall be available. Enhanced traffic engineering using MPLS-TP technology as per relevant IETF standards and MEF CE 2.0 certified and comply with all service standards and shall be supported the E-Line, E-LAN, E-Tree and E-Access services or similar standard.**

On TDM TRANSPORT LEVEL interfaces for optical transmission on STM-1 (155Mbit/s), STM-4 (622Mbit/s) and STM-16 (2.5Gbit/s) shall be available. For connection to higher order transport equipment also N x 2Mbit/s (E1) and STM-1 electrical interfaces shall be available. MPLS-TP and PDH/ SDH functionality shall be natively integrated (true hybrid functionality).

Static configuration of bidirectional and co-routed communication channels shall be supported using the NMS. Dynamic routing shall be prohibited for all critical data channels. End to end channel supervision should be supported. The equipment shall be software controlled, of modular design and all modules shall form an integrated part of a 19" shelf.

The platform shall have means to cross-connect, drop and insert individual channels (64kbit/s time slots), 2Mbit/s framed (G.704) and unframed (G.703) signals. It shall also support termination and cross connection of VC-12, VC-3 and VC-4. Each network element shall be manageable locally as well as from an operation center.

5.0 EQUIPMENT TECHNICAL REQUIREMENTS

5.1 Description

The proposed hybrid fibre optic communication equipment should provide a Network with aggregation layer at L2 Ethernet along with Legacy TDM interfaces and a Core/Backbone Network on MPLS-TP and SDH technology.

The primary function of the communication network is to provide a highly reliable voice, tele-protection and data communication system in support of the SCADA/EMS. The communications support requirement for SCADA/EMS system is for low & highspeed data, video & express voice circuits and administrative voice circuits & VOIPs.

The communication system shall provide data, video & voice connectivity across the various locations or connectivity of RTUs with Sub-LDCs and Sub-LDCs with MLDC.

The hybrid equipment shall be capable of transmitting and receiving the TDM & Ethernet channels independently and simultaneously (as per requirement) over MPLS-TP as well as SDH ports.

A brief summary of the communication system requirements is as follows:

- (a) Standalone distance tele-protection commands interface and line differential protection interface (Optical Protection relay interface C37.94) fully manageable under the same NMS.
- (b) 64kbps & nx64kbps data channels support
- (c) Low speed (300 -1200 bps) data channels support
- (d) 6 wires E & M channels support.
- (e) Data transport supporting Network Management channels both in SDH technology and in MPLS-TP technology.
- (f) the connectivity envisaged between RTUs/SAS and Control Centre in Wide Area Network (WAN) on TCP-IP using IEC 610870-5-104 protocol and serial using IEC 610870-5-101 protocol.

The Offered equipment should be modular type .

5.2 Packet Switched Capacity.

The central switching matrix shall at least support 60 Gbit/s in full duplex wire-speed switching capacity in a lower scale version and at least 100 Gbit/s in a higher scale version. IPv4 routing (preferably IPv4 & IPV6) shall be as an option with a capacity of at least 10 Gbit/s wired speed routing. Preferably the combination of MPLS-TP and IP routing interface card shall allow to offer L3 VPN services with fast L2.5 based transport functionality and IP routing at defined locations. This also supports VPWS (Point to Point) & VPLS (Point to Multipoint) services, to send the Ethernet traffic over MPLS-TP Link.

5.3 Circuit Switched Capacity.

The cross-connection functions shall be implemented in such a way that no single point of failure exists. The PDH cross-connect capacity shall be up to 128 x 2 Mbit/s non-blocking with a granularity of 64 kbit/s.

Additionally, Each SDH interface card shall offer a high-order SDH cross-connect capacity of up to 128x128 VC-4 and a low order cross-connect for VC-3 and VC-12 in the same SDH interface card with a capacity of up to 1008 x 1008 VC-12.

VC-4 & VC-12 SDH cross connect capacity shall be upgradable by adding additional SDH interface units.

5.4 Redundancy Capabilities.

The equipment shall provide enhanced redundancy features in order to ensure highest availability without any break in of the communication network. The following redundancy schemes shall be supported (Hot standby):

- Redundant or distributed cross connect
- **Redundant power feeding -48V (-15% / + 20%)**
- Redundant CPU functionality
- HW redundancy of SDH aggregate interfaces
- HW redundancy of 1 Gbit/s and 10 Gbit/s MPLS-TP aggregate interfaces
- HW redundancy of central Ethernet switching matrix
- Enhanced TDM traffic protection schemes
- SNCP/ MSP/ VCAT/ LCAS over redundant TDM aggregate modules
- Enhanced PSN traffic protection schemes
- Minimum 1:1 LSP protection switching
- xSTP and ERPS loop prevention
- Timing Unit : 1+1
- 1588V2: 1+1
- The cross connect capability between optical interface modules is to be provided at software level without any physical connectivity and without any limitation on cross connect capacity.

5.5 Traffic Protection Scheme.

1:1 Path protection

Minimum 1:1 protection of MPLS LSPs shall be supported. Switching from main to backup path shall be automatic, bidirectional and symmetrical. Configuration options shall exist for reversible or non-reversible operation.

1+1 Path protection

The equipment shall provide means to protect 64kbit/s PDH channels. The protection shall be end to end from one interface (Voice, data, protection signalling) to the other. It shall switch automatically from the main channel to the standby channel. It shall be configurable whether the system switches back to the main channel (reversible switching) or not (non-reversible).

If a path has switched to its standby route because the main route is disturbed this shall be indicated with an alarm. The switching shall be done within the multiplexer without using the Network Management System.

SNCP protection on VC-12, VC-3 and VC-4 level shall be supported. Switching from main to backup path shall be automatic. Switchover time shall be less than 50 ms. For utility critical applications symmetrical switching of TX and RX on VC-12 and 64Kbps level shall be supported.

1+1 Section protection

The equipment shall provide means to protect SDH STM-n sections (MSP). It shall be possible to use two independent links: one as the main and the other as the standby. The system shall automatically switch to the standby connection and generate an alarm if the main connection is disturbed. MSP shall be configurable as intra- and inter-card feature to provide aggregate interface as well as module protection. The switching shall be done within the multiplexer without using the Network Management System.

The main requirement of the network protection mechanisms is that they should be able to recover traffic very quickly (switching time should be less than 50 msec). Further, protection should also operate autonomously from the network operation center.

The equipment should comply with the following protection mechanisms:

Sub-Network Connection Protection (SNCP/N and SNCP/I)

Multiplex Section Protection (MSP)

2 Fibers MS-PRing (for STM-16 traffic rate)

RSTP/MSTP (for Ethernet L2 traffic)

G.8032 ERP V1.

MPLS-TP Fast re-Route (FRR)

EFRR (Enhance FRR)

Dual FRR

LSP Linear 1:1

PW Redundancy

E1 IOP

LAG on UNI Ports.

LAG on MOE (MPLS over Ethernet).

Protection Mechanism (Native Packet)

PW Redundancy

5.6 Tele-protection.

The offered MPLS-TP cum SDH (Hybrid) equipment shall support standalone tele-protection coupler for distance protection. For differential protection, IEEE C 37.94 compatible integrated tele-protection card unit shall be offered. The communication system has to ensure simple, reliable and secure operation. Both standalone distance protection coupler and differential protection interface card shall work on both TDM & MPLS-TP technologies.

Standalone distance tele-protection coupler.

- The protection coupler equipment shall be provided in such a manner that the time interval, between the trip signal received from the protection relay on the transmitting end and the instant trip signal sent to the protection relay at the receiving end shall not be more than 7mS.
- Accept protection command signals in the range of 24VDC ... 250VDC
- All inputs and outputs shall be isolated and with EMC immunity for harsh environment (see also table of compliance, emission and immunity)
- Transmit & Receive up to 8 protection commands bi-directionally. All the 8 commands shall be transmitted and received simultaneously.
- Both visual and audible alarm should be provided. To connect to external audible alarm two potential free change over relay contacts shall be provided in the alarm circuit.
- Three dry contacts shall be provided for each trip output.

Minimum required technical parameters.

Sl.No.	DESCRIPTION	Particulars
(1)	(2)	(3)
1.	Digital medium	G.703

2.	Transmission speed	2 Mbps.
3.	Communication interface	G.703 (2 Mbps)E1/ Co-directional interface/ Ethernet electrical interface (10/100 BASE-TX)
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).	$<1 \times 10^{-5}$
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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 Tele-protection 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 1ms. Precision. c. Possibility of daily automatic link check.	Shall be possible. Shall be available. Shall be possible
20.	Synchronization of real time clock	Inputs for external IRIG B & 1PPS signal

Failure of Protection coupler should not cause any trip output to protection relay.

- 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 compliant with tele-protection standard IEC 60834-1& IEC 61000. 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.

- All inputs and outputs shall be galvanically isolated.

The Opto-coupler input pick up threshold voltage shall be more than 70% of nominal voltage Cross connect and drop insert facilities for binary inputs shall be possible.

- Point to multipoint operation is required.
- 4 binary signals per 64 Kbps channel.

For Differential tele-protection coupler:

• The interface card shall be suitable to interface 4 trip command optical inputs of standard IEEE C37.94 MM at 820nm/850 nm and 4 trip command outputs of standard IEEE C37.94 MM at 820nm/850 nm to Differential Protection relays independently.

- Command Transmission time shall be less than or equal to 5ms.
- Periodical automatically initiated loop-tests
- Delay measurement and supervision of the Tele-protection channel including a warning if a configured threshold is exceeded
- Input de bouncing functionality shall be provided
- Input/ output command prolongation functionality shall be provided
- Command addressing: this function shall be used to prevent tripping if the signal is wrongly routed through the telecommunication network.
- It is the responsibility of the contractor / FOTE vendor to integrate the differential tele-protection coupler signal with other end existing FOTE of different make.

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:
 - a) Transmission time less than or equal to 12 mS.
 - b) Fail to trip: $< 1 \times 10^{-5}$.
 - 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.

5.7 Synchronization.

- It shall be possible to synchronize the equipment using an external clock source, derived from a network or from an internal oscillator. The synchronization shall be configurable and it shall be possible to distribute the synchronization to other equipment as well. The system shall have the means of switching to select the synchronization source as well as a means of preventing the system from creating synchronization loops.
- The equipment shall support synchronous Ethernet and a synchronization selection process based on ESMC (Ethernet Synchronization Message Channel).
- The precision time protocol (PTP) as defined by IEEE/ IEC shall be supported for frequency and time of day synchronization.
- For tele-protection event recording it shall be possible to synchronize the event recorder of tele-protection interfaces to a GPS. The GPS time shall be available for the Network Element time as well.
- Configuration support for SyncE and PTP synchronization shall be available e.g. by means of wizards or guided configuration.
- For TDM synchronization the equipment shall be capable of selecting the source of synchronization by means of SSM (Synchronization Status Messaging) on 2 Mbit/s PDH or SDH port or by means of a priority-based sequence.
- Synchronization - Multiple types of timing references should be available from multiple timing sources:
 - E1/T1 interfaces.
 - Preferably STM-1 & STM 4 CES.
 - An external input of 2.048 MHz or 2.048 Mbps
 - Synchronous Ethernet (SyncE) from GBE and 10GE.
 - G.813 internal clock, free-run, accuracy of ± 4.6 ppm
 - Precision Time Protocol (PTP) - IEEE 1588v2 PTP
 - Used in a unicast mode static provisioning as ITU-T G.8265.1
 - Used in multicast Ethernet encapsulation mode ITU-T G.8275.1
 - Must support at least the following 1588v2 PTP types
 - Boundary Clock (BC)
 - Ordinary Clock (OC) Master
 - Ordinary Clock (OC) Slave
 - Transparent Clock (TC)
 - Synchronization Status Message (SSM) support

- Jitter and Wander according to ITU T G.823, G.825.
- The system time must support PTPv2 as the Time-of-Day (TOD) source (RFC 6374) for OAM time stamping.
- Phase/time synchronization interfaces are needed . The requirement complies to ITU-T G.8271 (1PPS).
- The following GBE interfaces should be supported:
 - 1000BaseX
 - SX , LX, EX,ZX , Bi-directional, coloured.
 - 10/100/1000BaseT /Preferably GPON ONU interface
- The following SFP+ 10GE interfaces should be supported:
 - ER, ZR, SR, LR, BD, Colored, Tunable& smart SFPs.
- The offered equipment should support the following environmental conditions (operation mode):
 - ETSI-300-019-1-3 Class 3.1
 - Temperature range: -5°C to +55°C
 - Relative humidity: 5% to 95%
- The offered equipment should support the following:
 - EMC according to EN 300 386/2000
 - Safety according to EN 60950/2000
 - Laser Safety according to IEC 60825-1&2 (AS/NZS 2211.2)

5.8 Telephony.

The equipment shall support interconnection of telephony subscribers and PBX systems. Analogue as well as digital solutions shall be supported.

- Analogue two wire subscriber and four wire subscriber/ trunk solutions
- Digital VoIP subscriber and gateway functionality (SIP-Session Initiation Protocol)
- Power over Ethernet solutions
- Hotline services

5.9 Cyber Security.

The equipment shall support integration into a cyber-security architecture enabling cyber secure operation of a communication network.

- Authentication, Authorization and Accounting (AAA)
 - Local management port disabling
 - User roles (privilege-levels)
 - Radius based authentication

- Security relevant local event logging (audit log)
- Syslog
- Secured management communication
- SNMPv3
- SSH
- Denial of service (DoS) prevention for device functions and user traffic
- Rate limiters for different traffic types
- Firewall towards device management
- Traffic authentication and encryption
- Access Control Lists (ACL)

The equipment shall be of robust design and hardening shall be done considering cyber security aspects.

- **Preferably 802.1x dynamic port-based user authentication**

- MAC level Port security
- Customer-facing ports (UNIs) must not allow access to Management Network, even though Customer may use/spoof combination of MAC addresses, VLAN IDs, IP Subnet (Address) that are legally allowed access to Management network.
- Customer-facing ports (UNIs) must ensure that they do not have access to other customer's traffic in any way.
- In P2MP service, spokes must not be able to talk to each other, unless otherwise configured.
- OSPF Encryption with HMAC-SHA256 must be supported for the equipment management.

5.10 Quality of Service.

Hardware support to ensure device internal and user traffic quality of service shall be provided.

- ≥ 8 hardware queues per physical port
- Configurable scheduling profiles
- Priority mapping tables (DSCP, PCP, EXP, PHB, TC)
- Priority configuration for individual protocols (e.g. PSC, MCC, ...)

- Port and service based rate limiting (at least single rate two color marker (SR2CM))
- Configurable storm control for unicast, unknown unicast, multicast and broadcast per port.

6.0 Aggregation / Transport Interface Requirement.

6.1 SDH Interfaces:

The shelf should support minimum 4 interfaces that can assign by software to STM-1 or STM-4 or STM16 - all options should be supported including a mix. Non-blocking SDH matrix should support XC for VC-12/3/4 without any restriction.

The interface shall be designed for use on single mode fiber (conforming to ITU-T G.652 or G.655). The interface card shall be based on SFP technology and use LC/PC connectors.

The following main functions shall be supported.

- Prepared for STM-1/4/16 SFP's (small-factor pluggable units) for short, medium, long and extra-long optical communications (1310nm, 1550nm or xWDM)
- Prepared for electrical STM-1 (155Mbit/s) SFPs if required.
- Termination of the OS-,RS-,MS-, and VC-4 layer.
- Extraction and insertion of the SOH communications information
- Through connections of VC-12, VC-3 and VC-4
- Support of MSP (Multiplex Section Protection)
- Support of SNCP (Subnetwork Connection Protection)
- Ethernet over SDH (EoS) functionality based on GFP / VCAT / LCAS (minimum 32 EOS channels to be configured per Optical interface).**
- 1+1 SETS timing protection
- 1+1 hardware protection

The following maintenance functions shall be supported.

- Status indications
- Loops
- Restart after ALS
- Trail Trace Identifier (TTI) monitoring

- SFP inventory and diagnostics

6.2 MPLS-TP Functionality.

The following MPLS-TP functionality shall be supported:

- Static configuration of MPLS-TP tunnels via configuration tool or network management system
- Bidirectional MPLS-TP tunnels
- Priority handling using L2 / L3 class of service information
- Mission critical services & Guaranteed performance parameters for tele-protection applications.
- Port based MPLS assignment
- VLAN based MPLS assignment
- The following topologies shall be supported
 - Point to point virtual private wire services (VPWS)
 - Tree structures
 - Virtual private LAN structures (VPLS)
 - Hierarchical VPLS structures (H-VPLS)
- End to end Operation Administration and Maintenance (OAM) channel with at least the following functionality
 - Continuity check messages (CCM)
 - Remote defect indication (RDI)
 - Route tracing (LSP ping/ trace route)
- 1:1 or 1:n traffic protection with < 50 ms switchover time
- Management functionality using dedicated MPLS channel
- Circuit emulation of legacy services via MPLS-TP shall be supported.
- Monitoring throughput function facility for all channels to know the load& traffic up to lower level of the network.

6.3 Ethernet Requirements

- The proposed network shall support 802.3-2005 frame format

- The proposed network shall support automatic MAC address learning without impact on line-rate performance
- The proposed network shall support disabling MAC learning for point to point (ELine) Ethernet virtual circuits
- The proposed network shall support static MAC FIB entries as part of policy forwarding
- The proposed network shall support IEEE 802.3ad link aggregation and allow the configuration of a link bundling.
- The proposed network shall support 802.3ad aggregation across ports on one line card, distributed across line cards and a hybrid as it applies.
- The proposed network shall support Link Aggregation Control Protocol (LACP) as in 802.3ad
- The proposed network shall support disabling LACP on an 802.3ad link aggregate and relying on static configuration.
- The proposed network shall allow load balancing among member links in 802.3ad link aggregate based on any of the following parameters including any combination:
 - MAC header (Source/destination MAC address)
 - Top MPLS label
 - VLAN based forwarding
- The solution must support EPL, EVPL, E-LAN and E-TREE services.
- The proposed network shall support the participation and discard options for IEEE 802.3x Flow Control on access ports. Policing and bandwidth allocation
- The proposed network shall support the participation and discard options for IEEE 802.3ad Link Aggregation Control Protocol on access ports.
- The proposed network shall support 802.1x authentication on UNI Ethernet ports
- The proposed network shall support tunneling and discard options for all Bridge management group of protocols.
- The proposed network shall support programming Ethertype value for Q-in-Q tunneling globally and on port-basis.
- The solution must support 1Gbps and 10 Gigabit/s Ethernet client interfaces using pluggable optics.

- The proposed network shall support VLAN based VLAN stacking/tunneling with the ability to support multiple outer VLAN tunnels per E-UNI. The proposed network shall be able to apply multiple outer VLAN tags on a E-UNI based on inner/customer VLAN ID if the customer frame is tagged or a configurable VLAN ID for untagged frames.
- Preferably the proposed network shall support standard VLAN stacking/tunneling based on the IEEE 802.1ad Provider Bridge standard.
- The proposed network shall support VLAN ID Translation (not tunneling/stacking), i.e., translating VLAN ID received from customer to a different (network) VLAN ID at originating E-UNI and translating back to customer VLAN ID at terminating E-UNI.
- The proposed network shall support a jumbo Ethernet frame of more than 9000 bytes; Supplier to mention the max size supported
- Ethernet circuits must be completely transparent to customer traffic. Detail any traffic types that are not transparently carried across circuits.
- The solution should support color-aware and color-blind policing.
- The solution should support Broadcast Storm Control (BSC)
- Protected services must have a diversely routed backup path to which traffic is switched to in less than 50ms when the primary path fails.
- Protected services must failover to the backup path based on complete failure of the primary path and based on partial traffic loss (signal degrade).
- The solution must be capable of supporting CES at E1/T1/STM-1 (channelized) rate - All options must be available.
- The solution must support arbitrary network topologies including rings, mesh and partial mesh topologies.
- The solution must support VLAN swapping for EVPL services such that each side of an EVPL may use different VLANs or one side may be untagged with the other being tagged.
- The solution shall support data link OAM: ITU-T Y.1731 for Fault management and performance monitoring and 802.1ag CFM.
- The solution shall support 802.3ah EFM.
- The solution must support transparent transport of customer class of service markings when present, including 802.1p, IP DSCP and MPLS EXP
- Preferably the proposed network shall support IGMPv2/v3 snooping.

- The proposed network shall support the capability of designating an Ethernet port as a primary and another as a backup for that port. When the primary port is active, The proposed network will always receive and send traffic on the primary port. The proposed network could receive traffic on the backup port, but will not pickup that traffic as long as the primary port is active. When the primary port fails, the backup port becomes active and The proposed network immediately starts receiving and transmitting traffic on that port. The application of this requirement is to allow 1:1 redundancy on the client side. The proposed network shall support the primary and backup ports being on different slots. When the primary port recovers after a failure, The proposed network shall revert the primary port to the active state and the backup port to the standby state.
- Preferably the proposed network shall have UNI (User Network Interface) and NNI (Network Node Interface). Typically, UNI would be configured in 802.1Q mode or Q-in-Q mode and NNI shall be in MPLS-TP(P2P) or VPLS/H-VPLS (MP2MP) mode. In order to simplify the operation of the product it is intended that no restriction be placed on UNI and NNI ports and all the ports shall be capable to support any mode of operation.
- The proposed network shall support to configure all 4094 VID on all ports and at the same time support all 4094 VLANs simultaneously. The operator must be able to reuse the same VLAN-ID on a different port on the same switch and terminate it into a different PW.

6.4 Ethernet over SDH Requirements (Hybrid)

- Transport E/FE over SDH infrastructure using virtual concatenation and GFP mapping of the E/FE into virtual containers.
- Programmable bandwidth: between 1...63 VC12 or between 1...3 VC3
- Link Capacity Adjustment Scheme (LCAS) to allow dynamically changing of the payload capacity with hitless switching.
- The equipment should be compliant with the following ITU-T standards:
 - G.7041 for GFP framing
 - G.7042 (LCAS – Link Capacity Adjustment Scheme)
 - G.707 (SDH virtual concatenation)
- The proposed network shall support Ethernet MPLS PWs for Ethernet frames arriving over GFP-F frames over a VCAT group

6.5 Ethernet over MPLS-TP Requirements

- The proposed network shall support Ethernet MPLS pseudo wires per RFC 5462
- The proposed network shall support Ethernet MPLS PWs for Ethernet frames arriving over physical Ethernet interfaces
- The proposed network shall support static setup of Ethernet MPLS PWs
- The proposed network shall support raw mode and tagged mode encapsulation per IETF RFC 5462.
- The proposed network shall transparently pass customer BPDU control frames over MPLS PWs, by configuration on an attachment circuit level (e.g., VLAN ID, Ethernet port)
- The proposed network shall drop customer BPDU control frames over MPLS PWs, by configuration on an attachment circuit level (e.g., VLAN ID, Ethernet port)
- The proposed network shall support mapping of VLAN Tunneled/Stacked (Q-in-Q) Ethernet frames to a pseudo wire based on double look-up of outer and inner IEEE 802.1q VLAN IDs.
- The proposed network shall support the configuration of IEEE 802.1p user priority bits to MPLS PW EXP bit mapping on ingress when performing MPLS encapsulation. The proposed network shall be able to write the EXP bits accordingly.
- The proposed network shall support the configuration of IEEE 802.1d user priority bits + DEI to MPLS PW EXP bit mapping when performing MPLS encapsulation. The proposed network shall be able to write the EXP bits based on the outcome of this mapping
- The proposed network shall support rate limiting (policing) on all Ethernet interfaces per RFC 2697 and 2698.
- The proposed solution shall provide traffic management support with the following key functionalities:
 - dedicated traffic manager role in NMS enabling definition of traffic management related parameters for services
 - Service profiles, enabling a traffic manager to create “templates” for users configuring services
 - Queueing profiles and traffic scheduling algorithm should be configurable
 - Bandwidth reservation in NMS should be done

- QoS with rate limiting and optionally hierarchical QoS
 - The proposed network shall support L2 Ethernet classification based on physical port, IEEE 802.1q service VLAN ID (EVC), 802.1p user priority bits field value (EVC plus CoS), and IPDSCP/precedence bits (EVC plus DSCP). Any of these fields could be a wildcard in a given configuration.
 -
 - The proposed network shall support VPLS (Virtual Private LAN Service)
 - The proposed network shall support Hierarchical VPLS (H-VPLS)
 - The proposed network shall support Q-in-Q as access to a virtual switching instance
 - The proposed network shall support Ethernet MPLS PWs as access to a virtual switching instance
 - The proposed network shall support multi-class PWs with mapping between 802.1p bits and MPLS PW exp bits as defined for Ethernet MPLS PWs
 - The MPLS Packet Transport shall support mapping between incoming exp bits on MPLS PW spokes to VPLS MPLS PW exp bits on ingress upon transmission over the VPLS and on egress upon transmission on the spokes
 - The proposed network shall support MAC address flushing across the VPLS instance when it learns of a local topology change on the access network
 - MPLS-TP should allow pseudo-wire services for the following Ethernet Services:
 - Ethernet Line (E Line) for P2P connectivity, used to create Ethernet private line services, Ethernet based internet access services, and P2P Ethernet VPNs. These include:
 - Ethernet Virtual Private Line (EVPL): P2P connectivity over shared bandwidth. Service can be multiplexed at the user to network interface (UNI) level.
 - Ethernet LAN (E LAN) for multipoint to multipoint (MP2MP) (any to any) connectivity, designed for multipoint Ethernet VPNs and native Ethernet Transparent LAN Services (TLS). These include:
 - Ethernet Private LAN (EPLAN): Multipoint connectivity over dedicated bandwidth, where each subscriber site is connected to multiple sites using dedicated resources (so different customers' Ethernet frames are not multiplexed together).

- Ethernet Virtual Private LAN (EVPLAN): Multipoint connectivity over shared bandwidth, where each subscriber site is connected to multiple sites using shared resources. This is a highly costeffective service, as it can leverage shared transmission bandwidth in the network.
- Ethernet Virtual Private Tree (EVP Tree): An EVP Tree is an E Tree service that provides rooted multipoint connectivity across a shared infrastructure supporting statistical multiplexing and over subscription. EVP Tree is used for hub and spoke architectures in which multiple remote offices require access to a single headquarters, or multiple customers require access to an internet SP's point of presence (POP).

6.6 MPLS-TP Requirements

- MPLS-TP implementation should be based on NMS based provisioning of services.
- Tunnel OAM should be based on BFD.
- MPLS-TP OAM will be based on GAL/G-ACH concept) must work independently of control plane.
- OAM must work within the data plane, forward and backward traffic must follow the same path and optimal protection mechanism for all topologies including ring and star topologies (Segment, Ring and Linear protection).
- BFD OAM should be according with the ITU-T G8113.2 or later relevant document (IETF)
- The solution should use Hierarchical method to reduce and support the mesh of tunnels / Paths.
- The solution should support multi segmented pseudo wires.
- The proposed network shall support MPLS transport over Ethernet 802.3ad Link Aggregate
- The proposed network shall support switching of Ethernet frames carrying MPLS packets over Ethernet interfaces. In this case, the proposed network shall perform traffic load-balancing on LAGs based on MPLS labels, if this load-balancing criterion is enabled by configuration.
- The proposed network shall support static MPLS label addition, swapping and popping as specified in RFC 3032.
- The proposed network shall support Bidirectional Forwarding Detection (BFD) for MPLS LSP as defined in IETF draft draft-ietf-bfd-mpls-04.txt or any subsequent revision of that draft

- Setting BFD message frequency for both the transmission and minimum receive interval shall be as low as 3.3, 10, 100 msec.
- It shall support configuring failure detection time in absolute time or as a multiple of the receive frequency
- The proposed network shall support configuring the exp field value of the MPLS BFD messages
- The proposed network shall support MPLS ping in both ping and trace mode as specified in IETF RFC 6426
- It shall support Proactive Connectivity Verification, Continuity Check, and Remote Defect Indication for the MPLS Transport Profile as per RFC 6428
- The proposed network shall implement classbased queuing at each logical interface.
- Preferably the proposed network shall support hierarchical Queuing whereby a diffserv scheduling system can apply on an LSP basis.
- Preferably the proposed network shall support the definition of a Diffserv scheduling system per logical interface.
- The proposed network shall support rate limiting per interface and per sub interface on all interfaces.
- The proposed network shall support egress shaping per LSP.
- The proposed network shall support user configurable mapping between outer MPLS exp bits and Ethernet user priority bits per 802.1d
- The proposed network shall support MPLS PW encapsulation over GFP-F
- The proposed network shall provide the capability of setting the MTU size
- The proposed network shall provide the capability for configuring the PWID
- The proposed network shall support binding a PW to an LSP

6.7 OAM Requirements

- The proposed network shall support a full suite of OA&M features and functionality to easily monitor, administer and troubleshoot all the services.
- The proposed network shall support OAM framework as defined in RFC 6371 and requirements defined in RFC 5860
- The OAM support should be based on recommendations in G.8113.1 and G.8113.2. Operations, administration and maintenance mechanisms for MPLS-TP networks using the tools defined for MPLS

○The system shall support OAM for

- a) Detection & recovery of Path Defects
- b) Diagnosis of a Broken Path
- c) Preferably Service Level Agreement Measurement for Jitter, Packet Loss and Latency.
- d) Frequency of OAM Execution
- e) Inter-working for Fault Notification
- f) Detection of Denial of Service Attacks
- g) LSP/PW ping & trace route
- h) VPN ping.

Preferably the system shall support Ethernet OAM in full compliance with 802.1ag, 802.3ah , Y.1731 and MEF 16 for.

- a) Mac Pinging – Continuity Check
- b) Trace-route
- c) Loop-back Connectivity check
- d) Ethernet –Local Management Interface (E-LMI)
- e) Ethernet LMI to CFM (802.1ag) interworking
- f) Preferably 802.3ah to CFM (802.1ag) interworking
- g) Preferably Maintenance End Points (MEP) on switch ports
- h) Maintenance Intermediate Points (MIP)
- i) Connectivity Fault Management over 802.1ad links
- j) SNMP traps

The System shall support Link Layer OAM (802.3ah) with following functionalities

- a) OAM discoveries
- b) Link Monitoring
- c) Remote Loopback
- d) Remote Fault Indication

The OAM packet should interoperate with third party network element All attributes of OAM packets should be understandable by third part network

elements (attributes like timers, no. of retries, dead interval, enable, disable OAM etc)

OAM should inform the management system / third part application about the status of service, connection per box basis and per user basis. Details information should be available like ingress and egress value, connection ID, port ID.

- There should be mechanism to measure delay, jitter and round trip delay, packet loss and frame loss end-to-end for a given flow. The system should synchronize the counters on both ends.
- There should be mechanism to fetch delay, jitter and round trip delay, packet loss and frame loss for MOS, uni-cast & multicast.
- The exchange of OAM packets should be end-to-end with provision to count number of times connections were down. It should identify the status of link.
- OAM should provide mechanism for trace-route to help operator to trace the path from ingress to egress network element with details of intermediate element.
- OAM packet should be isolated to user's data packet and it should be given highest priority.
- OAM packet should have attributes pertaining to ingress and egress filter.
- OAM should run per connection basis. The connection can be made using VLAN, Port, or other attributes.
- The solution shall support debugging through Event Logs, Alarm Logs, Performance logs, debug files in Equipment.
- Selective debugging of data plane aspects shall be supported including logging of individual ACL rules, FIB events, etc.
- Configuration management: backup/restore of configuration from a remote system using standard protocols like FTP, or TFTP. All of these functions shall be able to be performed through in-band interfaces and OOB management Ethernet port.
- SNMP v1, v2c and v3 shall be supported.
- Intensive OAM processing shall be supported on per LSP/PW basis (GAL/GAch for every LSP/PW),
- Sub-50ms PG (protection group) processing needs to be implemented on per LSP/PW basis.

- The proposed network shall support RMTF (Remote Fault)/FEFI (Far End Fault Indication) capability over management plane
- The proposed network shall support loss of signal detection on local client interface and failure notification through DWDM/SDH network to remote client interface in less than 50ms via light turn off or generation of an 802.3ah message on that remote interface (local client interface shall be in port mode)
- The proposed network shall support 802.1ag Connectivity Fault Management standard
- The proposed network shall support AIS and RDI (also 802.1ag) for E-Line EVCs
- The proposed network shall discard customer frames that contain unassigned customer VLANs on 802.1q port (including untagged customer frames).
- The proposed network shall support tunneling/discard of customer BPDUs
- The proposed network shall support option to block native Ethernet traffic on an 802.1q port where customer does not have untagged traffic requirements.
- The proposed network shall support counters for number of broadcast, unicast, multicast, and unknown unicast frames flooded per VLAN.
- The proposed network shall support MPLS-TP OAM requirements per RFC 6427
- The proposed network shall support the MPLS-TP OAM bundled with MPLS-TP tunnel for the monitoring and the protection as per ITU-T Y.1711.
- The MPLS OAM or BFD packet sending interval should be user configurable down to 3.3 ms.

6.8 Scalability

- The product must support bidirectional SFPs 1G and 10G for fiber savings. Every UNI port must be able to support full range Customer VLAN IDs (total 4089 CVIDs), both in transparent and Channelized (mapped) mode. Different customer must be able to re-use same range of CVIDs if they are attached to different UNIs.
- Every customer VLAN IDs (total 4089 CVIDs) on each physical port should have at least 8 queues for customer traffic /QoS handling.
- Each physical port should have buffering inbuilt. (Mention the amount of buffer per interface in terms of ms)

- The solution should use Hierarchical method to reduce and support the mesh of tunnels / Paths.
- The solution should support multi segmented pseudo wires.

6.9 Management Communication Channel

- Support Management LAN interface for DCN.
- Support in-band MCC for Ethernet MPLS network.
- IPV4 and OSPF V2 should be supported.
- Management VLAN should be supported.

6.10 Security Requirements

- The proposed equipment shall support the following security features
 - 802.1x dynamic port-based user authentication
 - MAC level Port security
 - SSH support
- Customer-facing ports (UNIs) on the CE device must be disabled and should not forward any traffic as default security behavior.
- Customer-facing ports (UNIs) on the CE device must not forward any traffic even after it is enabled, until it is attached to a service, e.g. PW
- Customer-facing ports (UNIs) must not allow access to Management Network, even though Customer may use/spoof combination of MAC addresses, VLAN IDs, IP Subnet (Address) that are legally allowed access to Management network.
- Customer-facing ports (UNIs) must ensure that they do not have access to other customer's traffic in any way.
- Network control Protocols must not be coupled with customer control protocols to maintain the stability of the Provider network. Customer control-plane traffic such as BPDU, ISL etc. must be tunneled end-to-end without interacting with SP control-plane.
- In P2MP service, spokes must not be able to talk to each other, unless otherwise configured.

6.11 NETWORK MANAGEMENT REQUIREMENTS

- Concerning management domain as a set of managed resources subject to a common management policy (as per ITU-T M.3010), each management

domain must be provided with distinct management functions. However, the proposed system should provide end-to-end management of the entire Hybrid(SDH,PDH & MPLS-TP) transport network layers.

- The adequate information about proposed TMN system architecture implying all relevant detailed data about compliance with mentioned ITU-T recommendations as well as about technology-specific (SDH/Data) issues must be supplied.
- Detailed system and interface documentation, including specification of their capabilities as well as the state of compliance with ITU-T and ETSI standards is required.
- State of compliance with other related standards, in particular with ISO, IETF and TMF, is required. The list of complied industrial standards must be provided.
- TMN system must include following levels and components concerning network management and operation:
 - Element Management System (EMS),
 - Network Management System (NMS),
 - Remote Management Client (RMC),
 - Local Craft Terminal (LCT)
- The EMS should represent the HW and SW components used for managing of one or more NEs.
- The EMS should provide management across a subset of NEs on an individual or collective basis, typically across single vendor equipment.
- The EMS must perform management functions across the Element Management Layer (EML, as per ITU-T M.3010) of the TMN LLA. As an objective, a vendor independent view must be provided to the Network Management Layer (NML, as per ITU-T M.3010).
- The NMS should represent HW and SW components used for managing of an SMSN (SDH Management Sub-Network) as a whole.
- The NMS should provide end-to-end network view of the entire management domain enabling management of the NEs contained in the SMSN.
- The NMS must perform management functions across the NML of the TMN LLA. As an objective, a technology independent view must be provided to the Service Management Layer (SML, as per ITU-T M.3010).

- The NMS must have a Client/Server architecture enabling a scalable expansion of the Management capacity and tasks distribution.
- The Management System must have at least one NE that is connected to an OS, called a Gateway Network Element (GNE). An interface to establish this connection must be provided.
- The Management System must have Gateway Protection for GNE redundancy.
- Management solution must provide end-to-end view and manage of the entire domain.
- Both EMS and NMS must have MMI (GUI). Provided MMI must demonstrate similar look and feel for all SMSN involved. User-friendly MMI is essential.
- The offered management system must include a single unified NMS (network management system) and multiple EMSs (element management systems) for different product lines and/or scalability purposes.
- Single EMS and NMS to manage the network on the Access Metro and core
- All data/SDH/Optical trails as well as maintenance actions should be managed by the NMS (top to bottom).
- The NMS must support Control Map to enable easy viewing and impact assessment of the various management channels and links carrying them. This includes DCC and GCC.
- The NMS must support more than 2000 NEs and 20 concurrent users in a single NMS
- The NMS must support multiple physical and logical graphical views of the same network (Physical, Optical, ETH/MPLS, etc.) with Logical Element.
- The NMS must support Resource Domain Partitioning with fine granularity to allow different users access to different network resources (per NE/card/port/HO trail).
- The NMS must support Graphical network usage chart – graphically show used/free resources over the whole network or drill-down into a link. For links, it should be possible to display availability in case of network growth.
- The NMS must support Automatic PM History collection and built-in report generation (graphical and tabular) for Historical PM.
- The NMS must support multi-route trails (protection/restoration).
- The NMS must implement the Network Management Layer (NML) as defined in the TMN Logical Layer Model.

- The NMS must have standard interfaces, according to Multi Technology Network Management (MTNM) Framework, to both lower-level Element Management Layer (EML) systems and to upper-level Service Management Layer (SML) systems.
- The NMS must have a rich Graphical User Interface (GUI). It is required that it will be possible to perform any Network Management operation via GUI without the need for the user to perform Command Line Interface (CLI) commands.
- The NMS architecture must be based on client-server relationships using standard technologies.
- The NMS must scale to manage up to at least 1000 devices. List and describe the device management capabilities. Standalone and integrated Teleprotection shall be manageable through same NMS.
- At least up to 150 client applications must be supported simultaneously by one NMS server.
- The management system should support display of:
 - an Data logical layer showing Switches and the topology
- The NMS will allow the provisioning, monitoring, operation and troubleshooting of the entire network from a single interface location. The single unified NMS must support management of SDH, MPLS, Ethernet and DWDM over both optical fibers and microwave radio. Describe this facility, addressing amongst others the ISO conceptual model of all key functional areas (fault management, configuration management, accounting, performance management, and security management) of network management.
- It should be possible to present 3rd party equipment as topology links and trails
- An upper level management system is required. Management functions must be based on TMN concepts of management layering (as per M.3010). This system will provide unified management capabilities to the entire managed domain. The interface to upper Management level should be based on the CORBA Technology.
- Connectivity of the various management layers (NMS system and lower management systems, EMSs) must rely on a standard Management Communication Network (MCN). Both LAN and WAN connectivity must be enabled. Lower level management systems must be accessed directly or by MCN.

- The NMS should enable integration of additional equipment types (related technologies as well as multi-vendor sub-networks).
- Insertion and Removal of NEs should automatic once the function activated
- The management system will have the ability to integrate 3rd-party SNMP equipment.

6.12 System HW Requirements

- System must be designed in a way that would ensure that no database information would be lost at shutdown procedure.
- Backup management Workstation should be provided and ensure full Management Redundancy. All information must be mirrored automatically between the management stations in order to prevent data loss in case of a failure of the working station.
- Switching from active to the stand-by station and vice versa must be automatic or available only for the authorized operator. This action must be without any effect on the traffic.
- 2011/65/EU (RoHS 2).

6.13 System SW Requirements

- EMS/NMS Operating system (OS) must be based on a widespread commonly accepted latest version of OS, which is also independently commercially available. OS upgrading must not affect traffic, database, communication SW, EMS/NMS SW or other SW.
- EMS/NMS database must be a relational database and SQL support is mandatory. The database must be independently available. It must be possible to duplicate the EMS/NMS database. The upgrade of the database SW must be carried out without any data corruption and traffic interruption.
- EMS/NMS SW upgrading must be carried out without affecting traffic, EMS/NMS DB, OS or other SW.
- Functional concept of the proposed system must comply with the FCAPS Management Functional Areas function sets requirements defined in the ITU-T M.3400.
- SW reset (including hot reset) must not affect traffic or element configuration. Present SW configuration must be stored in each NE. It must be possible to store more than one SW version in each NE.
- In the case of management connection loss, traffic must not be affected and the performance monitoring data must be stored into NEs. This data must be

available to the operator view when connection with the management station is re-established.

- After a power break, NE must always return to its predefined settings in designated time that must not be longer than 30 minutes. That designated time must herein be stated.
- It must be possible to remotely download and activate SW to all NEs from the EMS/NMS. Both downloading and activating SW processes must not affect traffic.
- It must be possible to download data from EMS/NMS to all NEs such as NE configuration. It also must be possible to upload data from all NEs to EMS/NMS such as: performance and NE configuration. These processes must not affect traffic.
- Possibility of exporting configuration data using SQL must be available. The method of data export must be thoroughly described.
- It should be possible to select a number of trails from the trail list and print all their endpoints and resources, as well as selected attributes.
- A Timing Map window should enable the user to conveniently monitor the network's timing topology.
- The NMS should provide Customizable Alarms color codes.
- SW Enhanced Features
- A thorough description is required regarding the support and implementation of the following features in the proposed Management System:
- Automatic Path-finding End-to-End for SDH/MPLS-TP/ETHERNET/Optical trail creation at the NMS level using configurable criteria.
- Shared ducts allowing the user to specify the shared resources the link/trail may use. In case two links/trails use the same resources, the management system should be able to find out that the same resources are used by multiple links/trails.
- The NMS should provide a Utilization Map displaying the available resources on the various topology links for various rates provide a quick graphical analysis of the network load. Ranges and colors should be customizable. Apart from the color code, the user should be able to obtain the actual number, in fractional form (N out of M), of available resources of a given rate per selected link.

- The Bidder shall specify if the management system is capable of displaying the network in different technology layers (SDH/SONET, Data and Optic). This layered approach should enable the user to get a technology-centric view of the NEs and ports.
- In case the vendor's management system is capable of supporting different technology layers, he must specify the level of awareness between each layer (Full awareness, Partial awareness, and no awareness). The vendor must briefly explain the working functions for creating multi technology topologies for the last two options (Partial and no awareness).
- The vendor shall specify if the management system is capable of displaying virtual topologies: While projecting a physical element in a particular technology layer, each physical NE can be mapped as one functional element; hence, a NE with several optical modules will be displayed in the optical layer as a single icon. In the virtual topology, each-one of the optical modules may be separated into as many as Sub logical element (SLE) per port. The new SLEs can now be linked to each other and a much more intuitive representation of the technology's logic can be achieved.
- The Bidder shall specify if the management system can be used to complete the topology and represent external, passive or unmanaged NE and to which extent.
- A tool providing alarm notification by SMS (short messaging service) as well as email to operator/technician cellular phones, PDAs, and email accounts, should be available
- A Sophisticated Customer Network Management (CNM) providing the ability to partition the managed network's resources (domains) amongst various users/clients and assigning them different rights and capabilities (profiles) should be available. This will enable to lease ports, cards, or entire NEs to CNM clients, and give them the means to monitor or even manage these resources.

6.14 Performance Monitoring Requirements

- The following features should be provided:
- Performance monitoring data collection, processing, storage
- Source for Performance Monitoring (PM) data: TDM/Ethernet traffic
- PM data presentation using tabular and graphical report
- PM data query/search facilities

- PM database management:
- Automatic & manual PM data archive
- Automatic & manual PM data purge
- The NMS must provide information for all its managed elements via a single northbound interface.
- The NMS northbound interface must support at least one of the following:
- TM Forum's Multi Technology Network Management (MTNM) TMF-814 CORBA based standard.
- SNMP V3.
- The (MTNM) TMF-814 NMS northbound interface must support the following functionality: alarm management, performance management, physical and logical inventory management, topology management, trail provisioning and maintenance operations.
- The SNMP northbound interface must support alarms management functionality.
- The NMS must support at least five (5) concurrent northbound interfaces to five (5) Upper Level Management Systems.
- Different performance at the interface, device, and protocol levels will be collected on a regular basis. The polling engine in the network management system will be utilized for data collection purposes. The network management systems shall be capable of collecting, storing, and presenting polled data.
- The NMS will show all current values of 15M and 24H PM counters for that trail.
- The management system shall support display and collection of all PM data and counters supported by the NEs.
- Current PM data shall be visible from the management system on a per trail/service basis.
- Historical PM data shall be collectable to files for export/browsing.
- Historical PM data for ETH ports shall be collected and displayed as a report per port with graphical display of the information
- Historical PM reports need to support export to CSV and PDF files
- It will be possible to collect historical PM data into a dedicated database from which reports may later be retrieved in different cross-sections including:

- In table form
- In graph form
- In different aggregation periods
- For a given date range
- Per trail/service
- The management system shall support display and collection of multi technologies of optics, SDH and Data.
- The management system shall be able to track changes of the managed deployment and migration plan and reporting the system trends.

6.15 Reports and analysis

- The system must support inventory reports with details on total number of cards and sub cards installed in the network, the utilization of cards and ports in percentage and inventory attributes per element
- The system should provide detailed and flexible reporting capabilities to answer the following information requests:
 - Total no. of free service slots
 - Total no. of free client ports
 - Cards and ports installation and removal trend overtime – detailed per location, card type, operation, date
 - Total no. of installed cards and transceivers – in their name, type, category, location, part number, SW/HW version
 - Ability to generate report using customer part number per item
 - Cards configuration mismatch report – where card were wrongly configured nad hence do not function properly
- The system should have the capability to generate new, customized reports per demand
- The system should be able to send information by mail upon a threshold cross in any inventory value
- The system should be able to export reports in CSV, HTML, PDF and HTML formats.

6.16 PDH Interfaces.

A 2Mbit/s E1 module for electrical transport communication shall be supported. Each module shall provide at least 8 x 2 Mbit/s electrical ports according to ITU-T G.703. The ports shall be available for the synchronization source selection process. The interface shall be able to extract the 2.048 MHz clock for synchronization of the multiplex equipment. Support of SSM synchronization signaling shall be supported.

- **E1 (Minimum 8 per module)**

- Ethernet 10/100/1000BaseT (Electrical) and 100/1000BaseX (optical).

- **The Ethernet optical interface should support multi-mode and single Mode with LC connector.**

- Ethernet 10 GE and 1GBE Layer 2 including MPLS-TP capabilities
- Sub-E1: PCM interfaces (CES) over ETH and MPLS-TP:
- Analogue subscriber interface: subscriber FXS and exchange side FXO
- 4-wire E&M voice interface
- Programmable data interface V.24/V.28, V.35, X.24/V.11, RS-485 (2-wire/ 4-wire)
- Alarm collection interface
- Tele-protection command interface as per IEC 60834-1
- Optical interface module for protection relays compliant to IEEE C37.94 (850 nm/820 nm multimode).
- 2 Mbit/s electrical interface for unframed signals acc. to ITU-T G.703 and framed signals acc. to G.703 and G.704
- Circuit emulation function for E1, serial and telephony interfaces
- Ethernet interface 10/100/1000BaseT, electrical, RJ-45 or SFP based
- Ethernet Interface 100BaseFX and 1000BaseLX/SX, optical, SFP based
- Support of L2 switching functions
- Support of L3 routing functions (Integrated 12 port 100/1G base Optical/Electrical OSPF Routing Interface card with minimum 256 nos. VLAN router instance/ports. The routing capacity shall be 20 Gbits/s)
- Support of Power over Ethernet
- Ethernet interface supporting Ethernet over SDH (EoSDH, GFP ITU-T G.7041 and LCAS ITU-T .G.7042 functions).

6.17 CES (Circuit Emulation Service) Support:

SAToP (RFC 4553)

- CESoPSN (RFC 5086)
- E1 CES.
- The CES Optical interfaces with LC connector shall be supported.
- The E1 CES card shall at least 16 ports per module.
- Power over Ethernet (POE+) is required for minimum 2 of the Ethernet electrical ports.
- On TRANSPORT LEVEL the equipment shall support / future upgradable to the following connection ports:
 - Up to 8 x STM-16 SDH optical ports
 - Up to 16 x STM-4 SDH optical ports
 - Up to 8 x STM-1 SDH optical / electrical ports
 - Up to 8 x 1 Gbit/s MPLS-TP capable transport ports
 - Up to 8 x 10 Gbit/s Ethernet (MPLS-TP) ports
 - N x 2 Mbit/s electrical E1 ports
 - Up to 200 x electrical/ optical 1 Gbit/s Ethernet ports
 - To include physical port provision at Chennai, Erode and Madurai.

All optical MPLS-TP, SDH and Ethernet ports shall support SFP or SFP+ modules (small-form-factor pluggable unit) for short, medium, long and extra-long optical communication. ALS (Automatic Laser Shut-down) shall be fully supported.

6.18 Low Rate Interfaces

In order to ensure the connectivity required for future internal needs the proposed system should support the low rate data interfaces described in the following section. Therefore a 1/0 cross-connect capability should be integrated, when required according to the node interfaces/services configuration, in the equipment along with low rate interfaces.

The Low rate components should be modular and consist in three basic elements:

- Multiplexing and de-multiplexing of low rate data traffic
- The 1/0 cross-connect
- Low rate interface modules

6.18.1 Access / user Interface.

4-Wire Interface (VF interface)

This module shall provide connections for voice channels with a bandwidth of 300 Hz –kHz and 2 signaling channels ($M \Rightarrow E$, $M' \Rightarrow E'$) per voice channel. Each voice channel shall be configurable to operate with or without CAS. With CAS it shall use the "a" and "b" bits for the two signaling channels.

The level shall be software adjustable within the following range:

Input: +7.5 to -16dBr and Output: +7.0 to -16dBr

Modules where each voice channel can be individually configured with 1+1 path protection shall be available. This interface should support two main applications

Inter-exchange connectivity to support E&M interface types I to V.

Terminal equipment connections

- For Party line subscriber set, - For modems for data over voice transmission

6.18.2 Analogue Subscriber Interface(FXS)

The multiplexer shall support analogue Subscriber interface module for at least 10 subscribers and shall be expandable up to 30 subscribers. A module with at least 10 subscribers as well as high-density module for up to 30 subscribers shall be more preferable. The ringing generator shall be integrated on the subscriber module. The ringing frequency shall be adjustable for 20Hz, 25Hz, and 50Hz.

The following main functions shall be supported: Downstream signaling

- Ringing, Metering, Polarity reversal, Reduced battery, No battery Upstream signaling
- On/off-hook, Pulse and DTMF dialing, Flash impulse, Earth key General:
- Constant current line feeding, Line test, Permanent line checks, CLIP (On-hook VF transmission), Metering after on-hook

6.18.3 Exchange Interface(FXO)

This module shall provide at least 10 ports for connection to the ports for remote analogue subscribers of a telephone exchange (PAX, PABX). It shall provide the following functions:

- pulse dialing, tone dialing (DTMF), earth key function, metering function(12 kHz or 16 kHz), flash impulse, polarity reversal, indication of busy lines

The following parameters shall be configurable by software:

- Input voice level -5.. +4dBr, output voice level -7.5...-1dBr
- metering pulse enable/disable, signaling bit definition,

- loop back of voice to the telephone.

6.18.4 Party line Telephone System (Engineering Order Wire)

An engineering order wire (EOW) facility shall be provided at each multiplexer. Following options shall be available:

The EOW shall be configured as a party line and use in band DTMF signaling to call another EOW-Terminal. The Terminal shall have an integrated DTMF decoder allowing to program a subscriber call number (1..4 digits), and two group call numbers (1..4 digits each). EOW based on Voice over IP (VoIP). The EOW traffic shall be routed over the management channel.

6.18.5 Data Interfaces

Following interfaces shall be available for both Synchronous and asynchronous data transmission:

V.24/V.28, V.11/X.24, V.35, RS485 and shall support following bit rates:

Synchronous and asynchronous: 0.6 ... 38.4kbit/s

Synchronous: 48, 56, N x 64kbit/s (n = 1 ... 31) Following options shall be available: 1+1 path protection, Sub rate multiplexing, Point-Multipoint, Performance Monitoring.

6.18.6 IP/Ethernet Interface

Ethernet module shall comply with the following specification:

- Ethernet electrical connection: 10/100BaseT
- Ethernet optical connection: 100Base-FX and 1000Base-LX/SX
- Switching: bypass mode for IEEE Std 802.3 frame or based on port or VLAN tagID
- This module shall provide WAN connectivity of VC-12 or VC-3 and also support configuration of Logical WAN port.
- Framing: According General Framing Procedure (GFP) ITU-TG.7041
- Capacity: Virtual Concatenation (VCAT) acc. ITU-TG.707
- Protection: Link Capacity Adjustment Scheme (LCAS) acc. ITU-TG.7042

6.18.7 Alarm Interface.

The module shall provide means to collect at least 8 external alarms, which shall be displayed on the Network Management System. It shall be used to supervise

external equipment by the Network Management System. A minimum of 2 outputs, which can be controlled from the Network Management System, shall be available.

It shall be possible to label an alarm. The label-text shall be read from the interface module and visible on Network Management System as well as on the local craft terminal. The equipment failure shall be indicated with one audible alarm.

6.18.8 Optical Tele-protection Interface for differential protection.

This module shall have at least 4 optical ports, each of which is to interface with Numerical line differential protection relays through IEEE C37.94 multimode 820/850 nm of data rate n x 64 kbps user programmable at site. The optical port shall be suitable to drive the intended F.O. cable distance between numerical relay and FOTE equipment. Each interface shall support all 12 time slots (64 kbit/s – 768 kbit/s) in accordance with IEEE C 37.94. The ports shall be configurable to be used for 820/850nm, multi mode fiber.

Symmetry as well as jitter and wander values shall be guaranteed in order to meet application requirements regardless of the transport technology (TDM or MPLS-TP). IRIG-B outputs (optical and electrical) shall be available to pass on time of day information to end devices in case WAN supports transmission of accurate Time of Day information. Redundant communication channels in line with application requirements shall be supported.

6.19 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. E1 interface card (8 ports with cross connect at DS0 level) | - 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. as per Mfr. standard. |
| 10. Ethernet interface card 4 channels | |
| (User configurable from 64Kbps to 2Mbps) | - 1 no. or as per Mfr.standard. |

11. 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.

6.20 Management Interfaces.

The equipment shall make provision for an Ethernet port (henceforth called "local management interface") that allows access only to the local management agent (i.e. to the management agent running on the equipment itself but not to management agents running on remote equipment).

The equipment shall make provision for interface(s) that allow access to the management agent from a remote site through an IP network (henceforth called "routed management interface(s)").

The equipment shall make provision for a VLAN dedicated exclusively to the traffic to/from the management agent (out-of-band management). The VLAN identification must be configurable.

The priority of the traffic flowing through the routed management interfaces shall be configurable (i.e. capability to assign a Class of Service to the management traffic). It shall be possible to enable/disable the local management interface by configuration. It shall be possible to enable/disable the routed management interface(s) by configuration. The IP address of the local management interface shall be configurable with proper authentication. The IP address/addresses of the routed management interface(s) shall be configurable.

The local management interface shall be browser based one. It shall not participate in dynamic routing protocol (i.e. the local interface and its IP address are not propagated outside the local equipment). It shall be possible for a routed management interface to participate in a dynamic routing protocol. The participation shall be configurable.

The equipment shall support the following protocols for the communication between the management agent and the network management system (NMS)/craft terminal (CT):

- a. Telnet
- b. SSH
- c. SNMPv3
- d. SYSLOG

The equipment shall support the capability of sending event messages to up to ten different remote syslog servers. Each server is identified by its IPv4 address.

e. OSPF authentication

The equipment shall provide the capability to authenticate OSPF messages (e.g. MD5). This capability shall be provided for both DCN and user traffic OSPF capable routers.

f. Encryption

The equipment shall provide the capability to encrypt MPLS-TP traffic (end-to-end tunnel encryption). The encryption shall be provided by a plug-in self-contained unit (henceforth designated as "encryption unit") offering the following features:

- Eight (8x) SFP/SFP+ cages for electrical or optical 1 or 10 Gbit/s Ethernet
- AES-256 GCM Encryption

6.21. Specification for VOIP phone

Description	Minimum requirement of TANTRANSCO
Phone Book	Local Phonebook up to 1000 entries Black ListXML Remote PhonebookIntelligent Search MethodPhonebook Search/Import/Export Call History: Dialed/Received/Missed/ Forwarded
Audio Features	Full-duplex Hands-free Speakerphone with AECCodecs: G.711(A/μ), G.722, G.723, G.729, G.726, iLBCDTMF: In-band, Out-of-band (RFC 2833) and SIP INFOVAD, CNG, AEC, PLC, AJB, AGC
Display	Graphical display LCD/LED for Incoming/Ongoing Call, MWI, Mute, HoldIntuitive User Interface with Icons and Soft keys, Multiple Languages, Caller ID with Name, Number
Speakerphone	Full duplex
Phone Features	Handset (connects through an RJ-9 port) for the IP Phone ,Call Hold, Mute, DNDOne-touch Speed Dial, HotlineRedial, Call Return, Auto Answer, Call Forward, Call Waiting, Call Transfer, Local 3-way Conferencing, Direct IP Call without SIP ProxyRingtone Selection/Import/DeleteKeypad Lock, Emergency Call, Set Date & Time Manually or AutomaticallyDial Plan, XML Browser, Action URL/URIInstant Messaging (Web UI and Phone)
Power requirements	The phone shall be interoperable with IEEE 802.3af PoE ; -48 VDC / AC 230 v supply
Ethernet ports	2 x 10/100 Mbps LAN & PC Ports, 1xRJ9 port for hand set.
Networking and Security	SIP v1 (RFC2543), v2 (RFC3261)IPv6NAT Transverse: STUN ModeProxy Mode and Peer-to-Peer SIP Link ModeIP Assignment: Static/DHCP/PPPoEHTTP/HTTPS Web ServerTime and Date Synchronization using SNTPUDP/TCP/DNS-SRV (RFC 3263)QoS:

	802.1p/Q Tagging (VLAN), Layer 3 ToS, DSCP SRTP for Voice Transport Layer Security (TLS) HTTPS Certificate Manager AES Encryption for Configuration File Digest Authentication using MD5/MD5-session IEEE802.1X SNMP v1/v2
Management	Configuration: Browser/Phone/Auto Provision, Auto Provision via FTP/TFTP/HTTP/HTTPS for Mass Deploy Factory Reset, Soft Reboot, Package Tracing System Log
Environmental working conditions	• Operating Temperature: 0°C to 45°C • Operating Humidity: 10 - 95% (Non-Condensing)

7.0 Power Supply

The equipment shall operate from a nominal -48VDC (-15% / +20%) battery. The equipment should cut-off beyond this range and automatically restore in the operating range. The equipment shall support dual power feed (1+1 hardware protection) i.e. that two power sources can be connected directly to the equipment (two connection points). The operating voltage should be -48V (Positive grounded).

The equipment shall supervise the power source and provide corresponding alarm in case of loss of either power source. Necessary surge protection shall be provided to filter all surges.

8.0 Safety

The equipment shall be safe to use and shall comply with EN 60950-1 and IEC60255-27 Measuring relays and protection equipment product safety requirement.

9.0 Ambient Conditions

Storage and transport:

- Temperature range: - 25°C ... +70°C
- Humidity: max. 95% (no condensation)

Operation;

Temperature range: - 25°C ... +55°C

Humidity: max. 95% (no condensation)

10.0 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

11.0 Vibrations and Shocks:

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

12.0 Electromagnetic compliance:

The equipment shall comply with the EN 55022 class A, EN 61000-6-2, EN 61850-3, and shall be in conformance with CE.

13.0 Protection Classes:

The equipments supplied shall comply with IP44.

14.0 Identification:

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

15.0 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.

16.0 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.

17.0 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.

18.0 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.

19.0 Heavy Duty Surge Protector Requirements:

High quality surge protector/diverter of reputed make shall be provided by the contractor, for each equipment. Additional spare surge protectors shall be provided as per site requirement.

20.0 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.

21.0 Mechanical Construction

The equipment shall be available as a 19" shelf to be mounted in a 19" rack or 19" cabinet. It shall be of robust design. All modules shall be integrated in the same shelf. All connectors shall be accessible from the front and comply with international specifications.

22.0 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. 25 nos. of Baluns(120 ohm-75 ohm convertor) shall be provided for each FOTE equipment.

23.0 Equipment Racks and Enclosures

All equipment provided under this specification, shall be physically mounted in sub-racks and cabinets (enclosures).The Contractor shall determine and propose for the Employer approval, the type, size, weight and manner of installation for each location.

Equipment Sub Racks shall be steel/aluminium fabricated and finished on all surfaces. All metal and welds shall be thoroughly cleaned and sanded to obtain a smooth finish. All surfaces shall be treated for rust and primed to form a bond between metal and the finish coats of paint. All equipment racks, enclosures and equipment, including distribution frames, shall be clearly labelled with unique identifiers consistent with Contractor supplied floor plans and rack elevations. Dust and moisture protection shall be as per the IP41 specification, or better standard. The equipment cabinet shall be built in such a way that it prevents the entry of all type of rodents. Equipment cabinets (enclosures) shall be designed free-standing but shall be mounted to the floor. Cabinets (enclosures) shall have secure fitting, lockable, full-length front & back doors for access to hardware and wiring.

The Contractor is required to provide and install all additional necessary indoor and outdoor cable raceways. The cable raceways shall be in conformance with the following: (1) Signal cabling and power cabling shall require separate cable raceways. Signal and power cabling shall not share the same raceways and shall be installed as far apart as is practical. Adequate shielding shall be provided as required. **Especially, all the F.O. patch chords from FODB to FOTE cabinet shall be enclosed with minimum of 1" flexible standard steel hose.**

The Contractor shall be required to provide protection from lightning and transient voltages for all wideband communications equipment. Suitable surge voltage protection device shall be installed in all panels.

24.0 Earthing and Signal Grounding:

For each facility, the Contractor is responsible for meeting the following station and equipment earthing requirements:

- (1) All safety earthing and signal grounding shall be in full compliance with EMI/EMC requirements as per relevant international standards
- (2) Each cabinet (enclosure) or cabinet (enclosure) group shall include suitable signal ground and safety earth networks. The signal ground network shall terminate at a separate signal ground stud connection isolated from safety earth.
- (3) Each earth/ground network shall utilize copper bus bars, copper braids and/or 16 sqmm or bigger earth cable. All equipment earth/ground connections shall be made directly to the equipment chassis utilizing grounding lugs and secured metal-to-metal with star washers. Use of the enclosure frame, skin or chassis mounting hardware as part of the earthing/grounding networks, is not acceptable.

- (4) The safety earth network shall be connected to "earth ground" at the safety earth stud. The earth stud connection shall be sized for an external earthing cable equipped with a 2/0 solid copper lug secured metal-to-metal with star washers. Primary AC feeds and distribution within enclosures requires earthing wire connection to the safety earth stud.
- (5) The safety earth and signal ground networks shall be inter-connected only at the safety earth stud and signal ground stud. The Contractor shall extend the existing station earth to the equipment room using suitable G.I. earthing strip (50 x 6 mm), wherever required. . The Contractor is responsible for providing all required earthing/grounding cable and installation. Cabinet (Enclosure) and equipment safety earthing and signal grounding shall be subject to the Employer's approval. The Contractor shall be responsible for determining the suitability of existing station earth for the equipment to be supplied under this contract. In case existing earthing arrangement at the site is not adequate, the Contractor shall either make improvement in the existing earthing arrangement or make new earthing as per requirement.

25.0 NMS.

The network management system (NMS) shall have facilities to supervise, monitor, control and configure each equipment and the whole network. It shall have capabilities of fault, configuration, performance and security management. It shall provide various graphical views to the network such as geographical overview, logical network structure, and hierarchical view. The network management system shall allow to define different user profiles.

The NMS shall support end-to-end service provisioning for MPLS-TP as well as for TDM based services. For MPLS-TP based services, all service types (VPWS, Tree, VPLS) shall be supported by the end-to-end service provisioning functionality. The NMS shall perform channel calculations based on various parameters such as available bandwidth, number of hops, throughput, provisioned bandwidth/services and channel diversity requirements.

A comprehensive alarm management shall show current alarms such, that icons of the network elements change their colors according to the alarm level. The alarms shall be categorized as critical, major, minor alarms and warnings. A summary shall indicate the total number of alarms and warnings in the entire network. An alarm list shall list all alarms of the entire network according to the time of their occurrence. It shall be possible to filter alarms with various filter criteria. Operators shall be able to add comments to the alarms.

General:

Network Management System (NMS) shall be provided as a part of this procurement. This NMS 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 NMS 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.

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

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

The NMS 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 NMS 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 NMS 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 NMS. 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 25-1 through 25-3.

Table-25-1-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 -25-2- 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 25.3- 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. The required identical portable (Laptop)

computers, each complete with necessary system and application software to support the functions listed above, shall be provided.

Interfaces:

The NMS 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.

NMS Architecture:

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

- a. Database used in NMS.
- 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(All the licenses with respect to all the hybrid FOTEs, DTPCs, NMS etc., supplied under this contract shall be given at free of cost until the life time of the respective equipment/NMS).

26.0 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. The integration of new FOTE & multiplexer equipment in the already available NMS at MLDC Chennai/SLDC Madurai will be in the contractors scope.
- 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 & integration of other end substation terminal communication equipment with the newly proposed communication equipments will be in the contractor's scope even if the equipments are of different make.
- 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.

27.0 APPLICABLE STANDARDS:

The hybrid(SDH & MPLS-TP) FOTE equipment shall fulfill the latest version of ITU-T , IETF/IEEE/IEC, 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.

In addition to the above , the other relevant standards with respect to the equipment supplied shall also be complied.

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.

28.0 FUNCTIONAL REQUIREMENTS

The primary function of the communications network is to provide a highly reliable voice, data, Video conferencing 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-16 / STM-4 / 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 be capable of communicating MPLS-TP traffic in addition to the SDH traffic.
4. Local and remote status alarm supervision facilities.
5. Network Management System. (For SDH, MPLS-TP, DTPC, Multiplexers)
6. 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.
7. Wherever necessary, the differential protection interface cards which supports all types of differential relays (C 37.94 protocol)shall be provided for both ends of substation.

29.0 ALTERNATE ROUTING for both SDH & MPLS-TP traffic:

All fibre optic terminal equipments provided shall have redundant optical port for TDM traffic. For MPLS-TP traffic, no main & standby path is required. But the equipment shall have minimum 4 MPLS-TP directions or more according to the requirement of substation. For each direction minimum one path shall be of MPLS-TP traffic apart from SDH. 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, in so far as it does not negatively impact terms and conditions of the contract nor the requirements in this specification.

30.0 TESTING OF EQUIPMENTS:

30.1 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.

30.1.1 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 I SAT. The

contractor has the overall responsibility for planning and ensuring the success of the Phase 2 SAT.

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 30-1 and 30.2.

Table- 30.1 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- 30.2 - Network Management Subsystem Installation Testing

Item	Description
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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-30.3 summarises the minimum requirements for pre-commissioning testing of the wideband communications network.

Table -30.3 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.	

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.

30.1.2 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.

30.1.2.1 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.

30.1.2.2 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.

30.1.2.3 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.

30.2 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.

31.0 MAINTENANCE SUPPORT

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.

31.1 Continuing Maintenance Concept

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

31.2 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 moudule, 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.

32.0 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.

33.0 Maintenance support facilities in India

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

34.0 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.

35.0 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.

36.0 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.

37.0 DOCUMENTATION

37.1 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.

37.2 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.

37.3 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.

37.4 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.

38.0 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.

39.0 For Kiosk based substation:

For all the Kiosk based substations, the digital protection couplers/ Analog protection couplers shall be placed inside the kiosk room along with C&R panel. Necessary space for housing the protection coupler panels inside the kiosk shall be provided.

From each kiosk to control room, two separate 24/48 ADSS F.O. cable shall be laid in two different routes for redundancy. Each Kiosk shall be provided with adequate 48 Fiber FODBs for connecting the above fiber. Also in the control room, distribution frame with a 500 fiber connecting capacity shall be provided in a separate panel.

In each kiosk, suitable E1 to optical convertors shall be provided for communicating protection trip signal from distance protection relay within the prescribed time limit as per IEC standard through digital protection couplers. Also same quantity of optical to E1 convertors shall be provided in the control room beside FOTE panel. All the fiber patch chords necessary from relay to optical convertors, optical convertors to FOTE panels, FODB to optical convertors etc., shall be in the scope of contractor.

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GUARANTEED TECHNICAL PARTICULARS AND REQUIREMENTS –GTP

FOR FOTE EQUIPMENT WITH HYBRID TECHNOLOGY(SDH & MPLS-TP)

GENERAL		REQUIRED	OFFERED
Type of multiplexer		Hybrid, MPLS-TP and PDH/ SDH	
Complying to IEC/ ITU-T/ IETF recommendations		YES	
Transmission Capacity	Gbit/s Gbit/s Mbit/s	1/10 Gbit/s MPLS-TP STM-16: 2.5 STM-4: 622	

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 : 13⁰17' N to 13⁰18' N

Longitude : 80⁰18' E to 80⁰19' 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-1A (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

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 supplier shall submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. 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 have 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	

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