



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

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TITLE	DATE	06-05-19	06-05-19	06-05-19
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Fibre Optic Telecommunication System

GROUP

TBEM

W.O. No

87007

CUSTOMER	Tamilnadu Transmission Corporation Limited (TANTRANSCO)
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PROJECT	400/230-110 kV Substation at Vellalaviduthi
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Rev.	Date	Altered	Checked	Approved	REVISION DETAILS
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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

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

This section covers the specific technical requirements of SDH equipment, termination equipment & Telecommunication Management Network (TMN). This constitutes minimum technical parameters for the above item as specified by the customer (TANTRANSCO). 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 “TANTRANSCO”.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer : Tamil Nadu Transmission Corporation Limited (TANTRANSCO)

Name of the Project : 400/230-110 kV Substation at Vellalaviduthi

Refer Section - 3 for Project Details and General Specifications.

1.2 BILL OF QUANTITIES

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

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

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

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

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- 1.2.4 It is the bidder's responsibility to supply the entire accessories such as SFPs (including Remote ends), connecting cables, patch chords, LIUs etc, needed for the integration of OLTE and multiplexer with remote end equipments. The price of same shall be included in the quoted price.
- 1.2.5 It is the bidder's responsibility to integrate the proposed FOTE equipments with the existing communication equipment/ newly proposed equipments at remote end substations. Any item not specifically mentioned in the BOQ or technical specification, but is required for integration with remote end FOTE/ required to ensure compatibility between new and existing equipment shall be in bidder's scope of supply and shall be included in the quoted price.
- 1.2.6 The proposed FOTE equipments shall be configured through the already available NMS hardware & software at MLDC Chennai otherwise a new NMS system (preferably manageable for 200 substations) along with hardware & software equipment shall be supplied to Chennai MLDC at no extra cost for integrating the data of the newly proposed FOTE equipments.
Any visit to MLDC Chennai if required to ascertain the above requirement before submission of offer/during detailed engineering shall be in bidder's scope. Any charges for visit or charges for implementing the above requirement shall be included in the quoted price.
- 1.2.7 Necessary DC-DC converters if required for successful operation of the offered equipments shall be in bidder's scope of supply.
- 1.2.8 Proposed SFPs shall be compatible for all types of OLTE equipments as per IEC standard.
- 1.2.9 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). Power Supply Cable Terminal Blocks provided in the OLTE equipments shall be suitable for termination of 4C x 4 sq mm Cu power cable.
- 1.2.10 Any other commissioning/ technical support required for system commissioning to the satisfaction of TANTRANSCO/ 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.
- 1.2.11 Required quantity of Panels/ Cabinets for housing OLTE/ PDH/ Digital Protection Coupler/FODP etc. are deemed to be included in the offered price as per customer approved drawings. No price implication shall be entertained during execution and handing-over of the system.
- 1.2.12 Successful commissioning of all the Communication Links with the Remote end stations shall be in bidder's scope for this tender. Necessary co-ordination, modification and interfacing with remote end existing equipments as applicable shall be in bidder's scope.
- 1.2.13 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.
- 1.2.14 SAT & Commissioning of Tele-Communication System including Supervision of

Installation covers both local and remote ends for successful commissioning of each link.

- 1.2.15 Necessary site visits before quoting for this tender for collection of existing system data for proper co-ordination and interfacing with the remote end existing equipments shall be in bidder's scope.
- 1.2.16 Prices for additional Optical amplifiers, additional patch cords etc. as required to meet the requirement of line lengths specified shall be included in the quoted price for respective SFP/ Optical Interface Cards.
- 1.2.17 All SFP's shall be suitable for mounting in the SDH cabinets being offered.
- 1.2.18 Some of the items may not be ordered at all.
- 1.2.19 Anything not mentioned above but which may be required at a later stage as per site condition shall also be provided for successful data, voice and protection inter-trip signal integration. The price of same shall be included in the quoted price.

1.2.20 Unit Price of all the Cards/SFPs/Components

Break-up unit rates for the following Cards/SFPs/Components to be furnished with the offer for any addition/ deletion to the scope:

- i) 4 port STM-4 interface card
- ii) SFP/Optical interface card of each offered type
- iii) SFP – L 4.2
- iv) SFP – L 4.2x
- v) Multiplexer Rack
- vi) Cabinet with complete wiring, MDF & DDF
- vii) Power Supply Module
- viii) Control Card
- ix) 2 Mb interface card (for min. 2 x 2 Mb)
- x) 2W/4W E&M Card for 16 Trunk
- xi) FXO card for 16 subscriber
- xii) FXS Card 2W-sub loop/hot line for 16 subscribers
- xiii) Low speed data interface card V.24/X21 for 4 channels
- xiv) N x 64 kbps data interface card V.35 for 4 channels
- xv) Ethernet interface card 4 channels (layer-2 type)
- xvi) Optical patch cords with required end connectors of 10m length
- xvii) Optical Amplifiers (of each type) for the above mentioned SFPs

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

1.3 TECHNICAL QUALIFYING REQUIREMENTS:

Please refer Annexure-E

1.4 TYPE TEST REQUIRMENTS

The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in TANTRANSCO shall be applicable for all projects with similar

requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by TANTRANSCO or representative authorized by TANTRANSCO or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (Ten) years prior to the date of Technical bid opening, i.e. 21/08/2017. In case the test reports are of the test conducted earlier than 10 (Ten) years prior to the date of technical bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.

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

1.5 INSPECTION, TESTING AND ACCEPTANCE

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

1.6 DEVIATION

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

1.7 DOCUMENTATION

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

1.8 DOCUMENTS REQUIRED DURING TENDER STAGE

Following documents are required during tender stage:

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

1.9 PACKING

- a) All equipments shall be suitably protected, coated, covered or boxed and crated. To prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 1 year) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The bidder shall be responsible for any loss or damage during transportation, handling and storage.
- b) The Bidder shall include and provide for security, protection and packing the Equipment so as to avoid loss or damage during transport by any mode.
- c) All packing shall allow for easy removal and checking at site. Wherever Necessary, proper arrangement for attaching slings for lifting shall be provided. All

packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.

- d) The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- e) Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- f) Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- g) All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- h) Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- i) Notwithstanding anything stated in this clause the Bidder shall be entirely Responsible for any loss, damage or depreciation to the stores.

1.10 ENCLOSURES TO SECTION -1

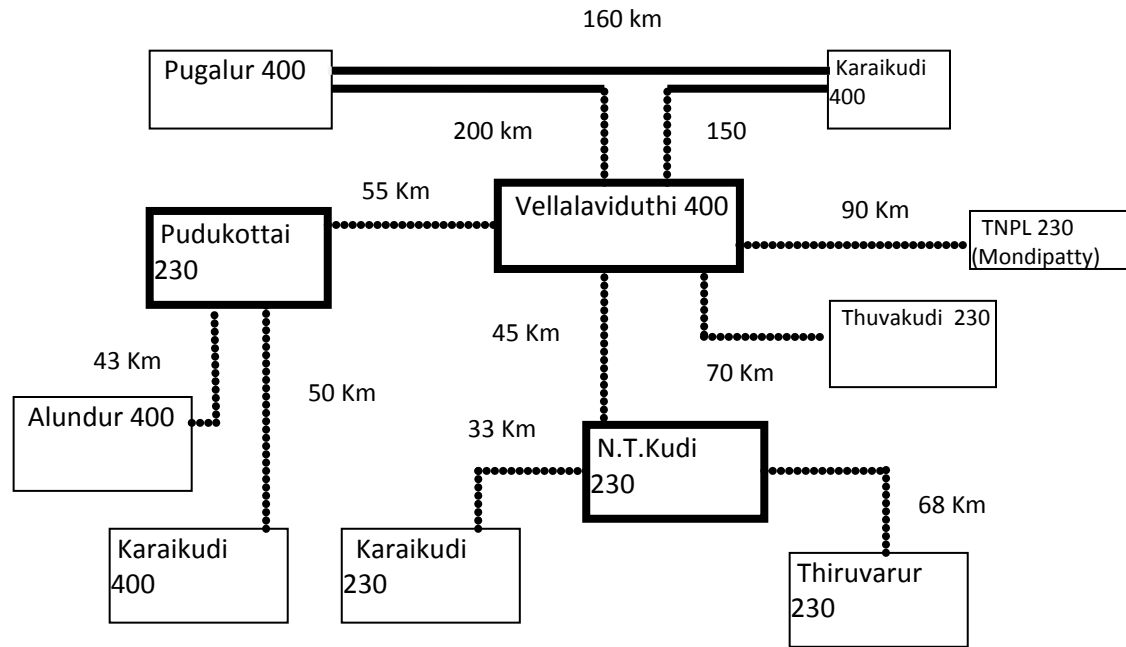
- 1) ANNEXURE-A : BOQ OF OLTE
- 2) ANNEXURE-B : Existing F.O Network & Proposed stations.
- 3) ANNEXURE-C : Digital Protection Coupler distribution.
- 4) ANNEXURE-D : Details of equipment in adjacent stations to the proposed stations.
- 5) ANNEXURE-E : Technical Qualifying Requirement.

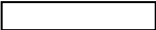
S.No.	Item No. as per Schedule -II of Contract : Supply of Electrical Equipments	Item Description	At Vellalaviduthi 400/230kV S/s	At Pudukottai 230kV S/s	At N.T Kudy 230kV S/s	At Karaikudi 400kV S/s (Vellalaviduthi-Karaikudi 400kV Line)	At Karaikudi 230kV S/s (Pudukottai-Karikudi 230kV Line)	At Karaikudi 230kV S/s (N.T Kudy -Karaikudi 230kV Line)	At Pugalur 400kV S/s	At TNPL Mondipatty 230kV S/s	At Thuvakudi 230kV S/s	At Alandur 400kV S/s	At Thiruvapur 230kV S/s	Total Qty to be supplied	Unit	REMARKS
			New Station	New Station	New Station	Tejas 1400 (Existing FOTE)	Tejas 1400 (Existing FOTE)	Fox 615 (Existing FOTE)	Tejas 1400 (Existing FOTE)	Tejas 1400 (Existing FOTE)	New Station	Tejas 1400 (Existing FOTE)	Fox 615 (Existing FOTE)			
I	Item No. 28	OLTE (Optic Terminal Equipments) - ADM Type = 3 Nos.														
I.1		1) SDH STM 4/ 16 Equipment	2	1	1	-	-	-	-	-	-	-	-	4	No.	Complete in all respect as per Technical specification excluding items under S.No. 1.3 to 1.7
I.2		2) SDH STM 1 / 4 Equipment	1	1	1	-	-	-	-	-	-	-	-	3	No.	Complete in all respect as per Technical specification excluding items under S.No. 1.3 to 1.7
I.3		3) Optical Interface card / SFP : STM L4.2 (Long haul) As per clause 4.0 of Technical specification	8	2	2	-	-	-	-	-	2	-	-	14	No.	Proposed SFPs shall be compatible for all types of OLTE equipment as per IEC standard.
I.4		4) Optical Interface card / SFP : STM L4.2x (Extra Long haul) As per clause 4.0 of Technical specification	6	-	-	-	-	-	-	2	2	-	-	10	No.	Proposed SFPs shall be compatible for all types of OLTE equipment as per IEC standard.
I.5		5)Optical Interface card to support minimum 175Kms (includes STM-L4.2x + Optical Amplifier) As per clause 4.0 of Technical specification	2	-	-	2	-	-	-	-	-	-	-	4	No.	Proposed SFPs shall be compatible for all types of OLTE equipment as per IEC standard.
I.6		6)Optical Interface card to support minimum 225Kms (includes STM-L4.2x + Optical Amplifier) As per clause 4.0 of Technical specification	2	-	-	-	-	-	2	-	-	-	-	4	No.	Proposed SFPs shall be compatible for all types of OLTE equipment as per IEC standard.
I.7		7) EMS/ NMS for OLTE and Multitplexers (Along with required Laptops , workstations and application softwares as per Technical specification)	1	1	1	-	-	-	-	-	-	-	-	3	No.	NMS shall be provided at MLDC, Chennai & SLDC , Madurai. All the 3 OLTE equipments shall be manageable through NMS from Chennai & Madurai.
I.8		8) Mandatory Spares : 20% of total BOM quantity of each type of SFP (Fraction rounded to next higher number) Minimum of - a) L4.2x- 2Nos., b) L4.2- 3Nos., c) L4.2x+Optical Amp.- 2Nos. For driving 175Km	1	-	-	-	-	-	-	-	-	-	-	1	Lot	
I.9		9) Mandatory Spares : 20% of total BOM quantity of each type of Sub-rack (Fraction rounded to next higher number)	1	-	-	-	-	-	-	-	-	-	-	1	Lot	
I.10		10) Mandatory Spares : 20% of total BOM quantity of each type of modules (including SDH module, PDH Module, Power supply module, alarm module etc along wit connectors, cables, tag block.) (Fraction rounded to next higher number)	1	-	-	-	-	-	-	-	-	-	-	1	Lot	
I.11		11) Mandatory Spares : Connectors for DDF connectivity	25	25	25	-	-	-	-	-	-	-	-	75	Nos.	
I.12		12) Mandatory Spares : Baluns (75Ohms to 120 Ohms) for DDF connectivity	25	25	25	-	-	-	-	-	-	-	-	75	Nos.	
I.13		13) Mandatory Spares : Co-Axial Cable for DDF connectivity	0.5	0.5	0.5	-	-	-	-	-	-	-	-	1.5	Km	
I.14		14) Tools and Tackles : Crimping tool suitable for crimping the connectors and cables supplied and for wiring .	1	1	1	-	-	-	-	-	-	-	-	3	Set	
I.15		15) Surge protection devices for supplied OLTE, Multiplexer & Digital protection coupler	2	2	2	-	-	-	-	-	-	-	-	6	Nos,	
II	Item No. 29	Cross Connect Multiplexer= 3 Nos.														
II.1		1) PDH Multiplexer	1	1	1	-	-	-	-	-	-	-	-	3	Nos.	
II.2		2) Cross connect for 16 E1 Ports	1	1	1	-	-	-	-	-	-	-	-	3	Nos.	

S.No.	Item No. as per Schedule -II of Contract : Supply of Electrical Equipments	Item Description	At Vellaviduthi 400/230kV S/s	At Pudukottai 230kV S/s	At N.T Kudy 230kV S/s	At Karaikudi 400kV S/s (Vellalaviduthi-Karaikudi 400kV Line)	At Karaikudi 230kV S/s (Pudukottai-Karikudi 230kV Line)	At Karaikudi 230kV S/s (N.T Kudy -Karaikudi 230kV Line)	At Pugalur 400kV S/s	At TNPL Mondipatty 230kV S/s	At Thuvakudi 230kV S/s	At Alandur 400kV S/s	At Thiruvapur 230kV S/s	Total Qty to be supplied	Unit	REMARKS
			New Station	New Station	New Station	Tejas 1400 (Existing FOTE)	Tejas 1400 (Existing FOTE)	Fox 615 (Existing FOTE)	Tejas 1400 (Existing FOTE)	Tejas 1400 (Existing FOTE)	New Station	Tejas 1400 (Existing FOTE)	Fox 615 (Existing FOTE)			
III.	Item No. 30	Digital protection coupler with E1 interface = 24 Nos.														
III.1		Digital protection coupler with E1 interface (8 Commands)	8	5	5	2			2	1	1			24	Nos.	
IV.	Item No. 31	EPAX : EPAX for PLCC system 48 subscribers and 16 trunks = 1No.														
		EPAX : EPAX for PLCC system 48 subscribers and 16 trunks	1	-	-	-	-	-	-	-	-	-	-	1	Nos.	
V.	Item No. 32	Telephone cable (0.6mm, 4 Pair) =4KM														
		Telephone cable (0.6mm, 4 Pair)	4	-	-	-	-	-	-	-	-	-	-	4	Km	
VI.	Item No. 33	Telephone for cc= 10Nos.														
		Telephone for cc	10	-	-	-	-	-	-	-	-	-	-	10	Nos.	
VII.	Item No. 126	Optical Time domain Reflectometer= 1 No.														
		Optical Time domain Reflectometer	1	-	-	-	-	-	-	-	-	-	-	1	No.	As per make and technical parameters specified in Technical specification..
VIII.	Item No. 127	Optical Power Meter= 1 No.														
		Optical Power Meter	1	-	-	-	-	-	-	-	-	-	-	1	No.	As per make and technical parameters specified in Technical specification..
IX.	Item No. 128	Optical Source = 1 No.														
		Optical Source	1	-	-	-	-	-	-	-	-	-	-	1	No.	As per make and technical parameters specified in Technical specification..
X.	Item No. 129	Optical splicing machine = 1 No.														
		Optical Splicing machine	1	-	-	-	-	-	-	-	-	-	-	1	No.	As per make and technical parameters specified in Technical specification..
XI.	-	Services : Training for 6 (Six) No. of TANTRANSCO Engineers on SDH, PDH Multiplexers and interface for differential protection/ protection inter-trip (as per clause 2.25 of Section-II) for a duration of 5 (Five) days at Manufacturer works.	1	-	-	-	-	-	-	-	-	-	-	1	Lot	As per clause 2.25 of Section-II of Technical Specification
XII.	-	Services : Lodging and boarding Charges for 6 (Six) Nos. of TANTRANSCO Engineers for a duration of 5 (Five) days at manufacturer works.	1	-	-	-	-	-	-	-	-	-	-	1	Lot	
XIII.	-	Services : To and Fro charges of 6 (Six) Nos. of TANTRANSCO Engineers for the Training at manufacturer works.	1	-	-	-	-	-	-	-	-	-	-	1	Lot	
XIV.	-	Services : Splicing of Fibres at Both ends of Link , including splicing at respective FODPs. (Link Wise)	-	-	-	-	-	-	-	-	-	-	-	10	Lot	Link Wise
XV.	-	Services :a) Support services as per clause 2.18 of Section-II of TS) b) Services for SAT (As per clause 2.5 of Section-II of TS) , GSAT (As per clause 2.6 to 2.10 of Section-II of TS) and Commissioning of Tele-communication system including Supervision of Installation (Link Wise)	-	-	-	-	-	-	-	-	-	-	-	10	Lot	Link Wise
XVI.	-	Services : Maintenance & Technical support services (as per clause 2.14 , 2.17 , 2.19 & 2.20 of Section-II of TS)	-	-	-	-	-	-	-	-	-	-	-	1	Lot	l

ANNEXURE-B

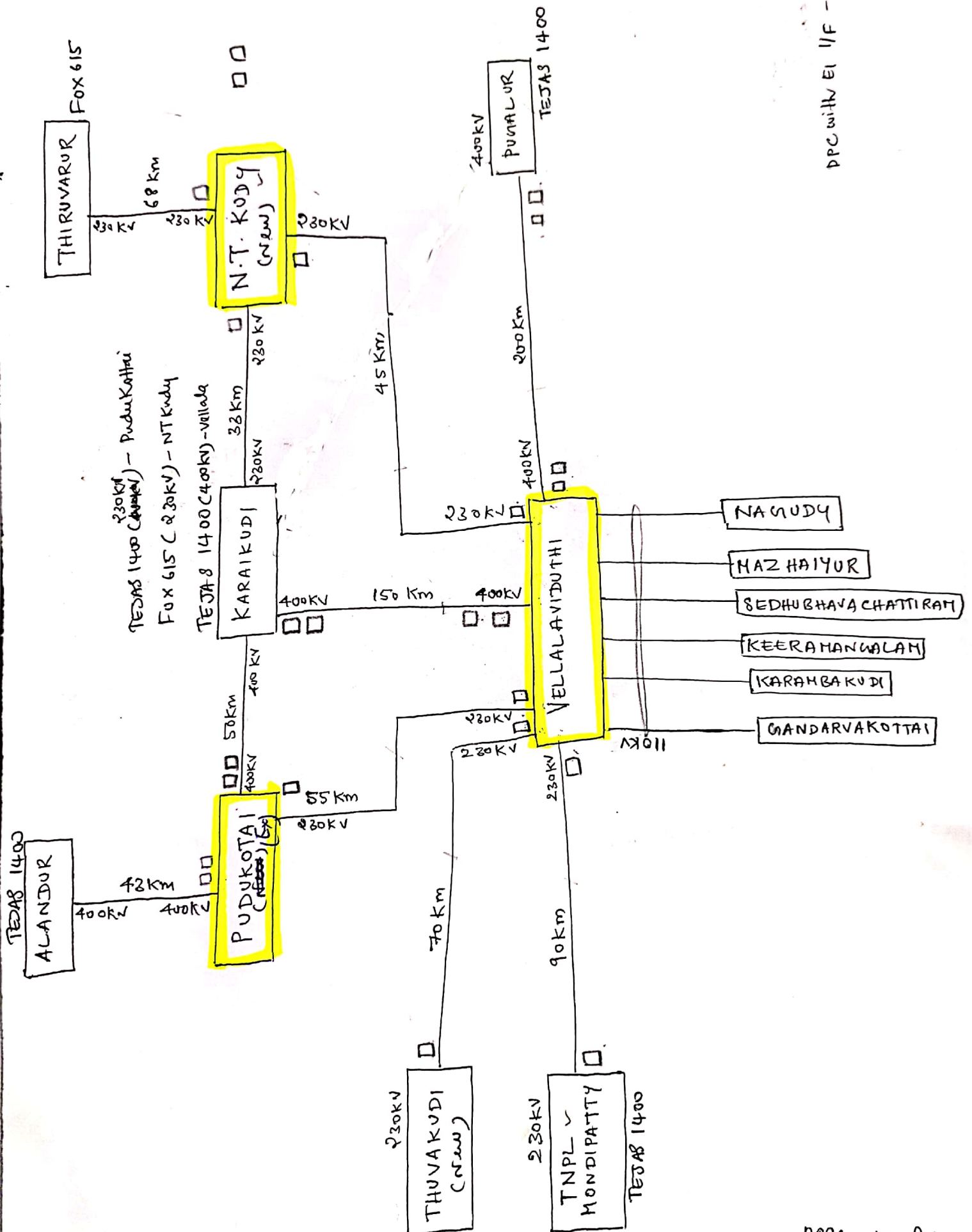
EXISTING F.O. NETWORK & PROPOSED STATIONS IN THIS TENDER



 Existing stations

 OLTE Proposed stations

APPENDIX - 3 DPC DISTRIBUTION



DPC with EI 1/F - 24 Nov.

ANNEXURE-D

DETAILS OF EQUIPMENT IN ADJACENT STATIONS TO THE PROPOSED STATIONS

Sl. No.	Name of the station	Adjacent station	Eqpt. In adjacent station	
1.	Vellalaviduthi 400	Pugalur 400 kV SS	Tejas 1400	
		Karaikudi 400 kV SS	Tejas 1400	
		Pudukottai 230 kV SS	New Stations	
		N.T.Kudi 230 kV SS		
		Thuvakudi 230 kV SS		
		TNPL 230 kV SS	Tejas 1400	
2.	N.T.Kudi 230 KV SS	Thiruvavur 230 kV SS	Fox 615	
		Karaikudi 230 kV SS	Fox 615	
3.	Pudukottai 230 KV SS	Alundur 400 KV SS	Tejas 1400	
		Karaikudi 230 kV SS	Tejas 1400	

ANNEXURE-E

TECHNICAL QUALIFYING REQUIREMENTS:-

The bidder should have designed, tested, supplied and commissioned OLTE equipments for 400kV system or above to Electricity boards/ Power utilities in India during the last Ten (10) years and the same should have been in satisfactory operation(#) for a minimum period of Two years as on date of technical bid opening ie. 21/08/2017.

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

SECTION -II
FOTE SYSTEM

1.0 INTRODUCTION

1.1 GENERAL:

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

Sl. No.	Station – A	Station – B	Distance between A & B in Kms.
1.	Vellalaviduthi 400 kV SS	Pugalur 400 kV SS	200
2.	Vellalaviduthi 400 kV SS	Karaikudi 400 kV SS	150
3.	Vellalaviduthi 400 kV SS	Pudukottai 230 kV SS	55
4.	Vellalaviduthi 400 kV SS	N.T. Kudi 230 kV SS	45
5.	Vellalaviduthi 400 kV SS	Thuvakudi 230 kV SS	70
6.	Vellalaviduthi 400 kV SS	TNPL 230 kV SS(Mondipatty)	90
7.	Pudukottai 230 KV SS	Karaikudi 400 KV SS	50
8.	Pudukottai 230 KV SS	Alundur 400 KV SS	43
9.	N.T.Kudi 230 KV SS	Thiruvavarur 230 KV SS	68
10.	N.T.Kudi 230 KV SS	Karaikudi 230 KV SS	33

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

2.0 SCOPE:

The scope of the project includes:

- Design, engineering, manufacture, transport, installation , testing and commissioning of Synchronous Digital Heirarchy (SDH) equipments and PDH Multiplexers with Cross connect & with standalone Digital Protection couplers.
- integrating the new F.O. links with the existing F.O. network.

- c) Provision of an efficient Element Management System licensed to accommodate atleast 200 Network Elements and capable to accommodate atleast 300 Network Elements.
- d) All cabling, wiring, patch facilities, equipment DDF's and interconnections to the supplied equipment side of the defined interfaces.
- e) Supply of testing instruments & mandatory spares.

3.0 **EXISTING COMMUNICATION FACILITIES:**

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

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

Optical Attenuation per Km. of fibre = 0.3 dB

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

Sl. No.	Name of the Fibre Optic Link	Dist. Km	Fibre Loss @ 0.3 dB/Km in dB	Connector loss dB	Mtce. margin dB	Tx-Rx margin required dB	Eqpt. Type proposed	Tx-Rx Margin available dB
1.	Vellalavidithi- Pugalur 400	200	60	1.0	3.0	64	STM-4-L4.2x+ 40dB OA	76
2.	Vellalaviduthi- Karaikudi 400	150	45	1.0	3.0	49.0	STM-4-L-4.2x + 20 dB OA	56
3.	Vellalaviduthi- Thuvakudi 230	70	21	1.0	3.0	25.0	STM-4-L4.2x	36
4.	Vellalaviduthi- Pudukottai 230	55	16.5	1.0	3.0	21.0	STM-4-L-4.2	25
5.	Vellalaviduthi-TNPL 230 SS	90	27.0	1.0	3.0	31.0	STM-4-L-4.2x	36
6.	Vellalaviduthi- N.T.Kudi 230	45	13.5	1.0	3.0	18.0	STM-4-L-4.2	25
7.	N.T.Kudi – Thiruvarur 230	68	20.4	1.0	3.0	25.0	STM-4-L4.2x	36
8.	N.T.Kudi – Karaikudi 230 KV	33	10	1.0	3.0	14.0	STM-4 – L4.2	25
9.	Pudukottai- Karaikudi 230	50	15	1.0	3.0	19.0	STM-4-L4.2	25
10	Pudukotai- Alundur 400	43	13	1.0	3.0	17.0	STM-4-L4.2	25

5.0 GENERAL REQUIREMENTS:

The work covered by this specification shall include design, manufacture, factory tests, supply, training, installation, cabling, field tests and commissioning of SDH equipments and PDH Multiplexers with Digital Protection couplers to be provided by the Contractor. The Bidder is encouraged to offer standard products and designs. However, the Bidder must conform to the requirements and provide any special interface equipment necessary to meet the requirements stated herein. **It should be noted that all preliminary design information (such as distance between stations) are provided for bidding purposes only. The Contractor is responsible for the final design and system performance.**

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

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

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

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

6.0 GENERAL RESPONSIBILITIES AND OBLIGATIONS:

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

Contractor's Responsibilities and obligations:

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

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

- a. Engineering, design, transfer of technology , training of Employer representatives, supply, testing, integration, delivery to the stores/site, unloading, storing, handling and moving to the final position, installation, testing and commissioning for successful commercial operation of the system.
- b. Equipment engineering and design specific to each site where equipment and systems supplied on this project will be located, including review of conformance with local environmental and earthing considerations.
- c. Engineering and technical assistance during the contract and warranty period.
- d. Equipment necessary to ensure compatibility between new and existing equipment.

- e. All hardware, software and firmware required to satisfy the requirements of this specification.
- f. Factory and field testing of the all hardware, Software and firmware provided.
- g. Providing a Quality Assurance Plan ensuring Employer access to the manufacturing process.
- h. Installation and integration of all Contractor(s) supplied communications equipment into the existing network.
- i. All documentation and drawings as specified.
- j. All required spare parts, spare cards price, maintenance aids, and test equipment.
- k. All cables and wiring needed to expand/supplement existing Digital Distribution frames (DDF) as necessary for proper operation of the wideband network.
- l. An availability analysis showing MTBF (mean-time-between-failure) and MTTR (mean-time-to-repair) figures for all system components.
- m. Planning for a smooth transition from existing operations to network operations, including all new equipment.
- n. Hardware, software, and firmware maintenance, debugging and support of the equipment through final acceptance and maintenance on all new equipment through the warranty period.
- o. Availability of service, spare and expansion parts for all equipment for a minimum period of **10** years from the date of operational acceptance by Employer or 7 years after the declaration of withdrawal of equipment from production whichever is later.
- p. Any minor modifications such as drilling necessary holes in floors for laying the cables will be the responsibility of the Contractor.
- q. Supply, laying and termination of cables from AC/DC panels to the equipment supplied by the Contractor will be the Contractor's responsibility.

- r) Provision of separate Communication earth as per the requirement or as per standards.
- s) Necessary optical attenuators shall be provided wherever required as per the prevailing field conditions.

Employer's Responsibilities and Obligations:

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

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

8.0 APPLICABLE STANDARDS:

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

- 1) Functional characteristics; G.957,G-783, G-764.
- 2) Transmission interface characteristics:
Optical fibre: G-652,G.653, G.655.

Optical interface G-707, G-957.

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

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

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

Mapping & Demapping G-707.

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

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

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

9.0 FUNCTIONAL REQUIREMENTS

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

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

10.0 ALTERNATE ROUTING:

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

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

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PART-II SECTION-II

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

TECHNICAL SPECIFICATION

SCOPE:

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

Sl. No.	Name of the station	Quantity required				No. of SDH links to be connected
		STM-1/4 SDH	STM-4/16 SDH	PDH Multiplexer with Cross-Connect	Digital protection couplers (8 command)	
1.	Vellalaviduthi 400 kV SS	1 No.	2 Nos.	1 No.	14 Nos.	6 directions
2.	N.T.KUDI 230 kV SS	1 No.	1 No.	1 No.	5 Nos.	3 directions
3.	Pudukottai 230 kV SS	1 No.	1 No.	1 No.	5 Nos.	3 directions
	Total	3 Nos.	4 Nos.	3 Nos.	24 Nos.	

SDH Equipment :

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

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

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

Functional Requirement:

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

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

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

Table -2-1 - Fibre Optic Transceiver Characteristics

Optical Wavelength	1310/1550nm *NOTE
Optical Source	Laser.
Optical Source Lifespan	Better than 5 X 10 ⁵ hours
Optical Fibre type	DWSM
Optical Connectors	Type ST-PC Option 1 Type FC-PC Option 2
Jitter Performance	Per ITU-T Recommendation G.823

Source Primary Power	-48Vdc
Relative Humidity, non-condensing	10-100%
Elevation: Operating Non-operating	To 3000 meters To 10000 meters
Temperature Range: - To Manufacturer's Specification. - Operation without damage - Shipping/storage.	(Non-environmentally controlled) 0 to + 50° C -10 to + 55° C -40 to + 60° C
<u>Temperature Stabilization:</u> Meet or exceed operational performance requirements through entire temperature range as specified in Section .	
<u>Eye Safety for laser Equipment:</u> To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction.	

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

Service Channel:

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

Supervision and Alarms:

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

Table-2 -2 Fibre Optic Terminal Alarms:

Alarm	Cause
LED/Laser Failure	Drive Current Low Threshold Drive Current High Threshold
Receive Failure	Optical Receive Low Threshold
Transmit Frame Alarms	HDB3 Loss of Input Distant Alarm Indication Signal (AIS) Local AIS
Receiver Frame Alarms	$BER > 10^{-3}$ $BER > 10^{-6}$
Regulator Alarm	Clock Recovery (Synchronization Loss)
Power Supply/Converter Alarm	Failure, Low Voltage Thresholds

Quality Parameters.	Per ITU-T Rec. G.821/G.826
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Higher Order Multiplexing:

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

Digital Distribution Frame (DDF) and Patching Facilities:

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

SDH equipment requirement:

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

Power supplies:

The SDH equipment shall have its own power supplies with fuses, isolators etc., The Power supply shall have over voltage, under voltage, short circuit, reverse power and surge protection. As soon as the normalcy in voltage, current and surge conditions are restored, the power supply unit shall restart on its own without need for manual switching.

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

Cross connect:

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

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

Optical module:

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

Ethernet module:

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

The following features shall be supported in this module

SFP Slots for Gigabit Ethernet Optical – 2 Nos.

ETH ports minimum 4 port

ETH 10/100 Base T.

Auto sensing.
Flow control 802.3x configurable (On/Off)
EoS mapper.,
ITU-T G.707 (Virtual concatenation)
G7041 (GFP) or X.86(LAPS) configurable.
G.7042(LCAS)

Interface with Protection relays:

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

Interface card for Differential Protection:

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

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

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

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

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

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

Alternatively

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

DIGITAL PROTECTION COUPLER:

General:

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

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

The protection coupler offered shall have input and output capacity of

8 channels each.

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

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

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

Three dry contacts may be provided for each trip output.

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

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

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

The Protection Coupler shall be of Digital version.

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

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

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

The Protection coupler shall be software programmable.

Performance requirements:

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

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

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

Additional points:

All inputs and outputs shall be galvanically isolated.

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

Point to multipoint operation is required.

8 binary signals per 64 Kbps channel.

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

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

System Availability:

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

Clock signal:

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

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

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

1. PDH Multiplexer:

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

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

It shall be totally software configurable without any hardware settings.

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

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

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

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

It shall have at least two programmable alarm outputs.

It shall be capable of supporting following voice interfaces:

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

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

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

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

Clocking:

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

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

Modularity and Hot swapability.

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

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

It shall be hot swappable.

Configuration of PDH Multiplexer:

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

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

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

ELEMENT MANAGEMENT SYSTEM (EMS):

General:

Element Management System (EMS) shall be provided as a part of this procurement. This EMS shall provide the capability to monitor, reconfigure, and control elements of the equipments supplied under this procurement. The above capability shall be provided at centralized location, Chennai. The EMS shall be capable of managing minimum of Hundred Nos.(100 Nos.) Network Elements and shall be upgradable to manage 200 Nos. Network elements minimum in future.

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

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

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

Technical Characteristics – General:

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

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

CONFIGURATION MANAGEMENT

General Requirements:

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

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

Fault Management:

General Requirements:

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

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

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

Power Failure:

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

Performance Management:

General Requirements:

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

- a. Monitor point to point and end to end signal quality & history.
- b. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:
 - 1. Select/deselect network equipments, events, and threshold parameters to monitor.

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

Security Management:

General requirements:

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

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

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

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

Human error and conflict detection are also required. Such errors and access violations shall be reported to the offending user as error messages & warnings. Repetitive violation of security measures shall generate an intrusion alarm, which shall be logged and displayed at all authorized operator management stations. Physical intrusion detected should be reported as an alarm condition.

Operator Authorization Levels:

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

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

Monitoring Level

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

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

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

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

Master Level:

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

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

Alarm Indications:

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

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

Equipment Requirements:

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

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

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

9	Configuration Status
10	Power Supply/Converter Alarms

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

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

Table 2-5- Station Alarms, Indicators and Controls

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

NMS Configuration:

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

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

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

Interfaces:

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

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

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

EMS Architecture:

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

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

Environmental Requirements:

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

Temperature and Humidity

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

Temperature Range:	(Non-environmentally controlled)
To Manufacturer's Specification	0 to + 50 °C
Operation without damage	-10 to + 55 °C
Shipping/storage	-40 to + 60 °C
Max rate of change of temp	0.5 °C / min
Ventilation	Natural
Relative Humidity, non-condensing	10 – 100 %

Biological Conditions:

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

Chemical Influence:

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

Vibrations and Shocks:

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

Electromagnetic compliance:

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

Protection Classes:

The equipments supplied shall comply with IP44.

Identification:

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

Equipment Labelling:

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

Power Distribution:

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

Signal Cabling:

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

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

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

Connectors and Sockets:

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

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

Heavy Duty Surge Protector Requirements:

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

Cabling:

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

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

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

Compliance of standards:

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

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

Transmission interface characteristics:

Optical fibre: G-652.

Optical interface G-707, G-957.

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

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

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

Mapping & Demapping G-707.

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

Equipment Shelf:

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

TESTING OF EQUIPMENTS:

2.5 SITE ACCEPTANCE TESTS

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

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

2.5.1 Site Acceptance Tests

2.5.1.1 The Site Acceptance Test (SAT)-I.

Site Acceptance Test for Telecommunication Equipment and Subsystems

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

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

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

(b) Phase 2 SAT (Integrated System Tests)

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

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

2.5.2.1 Phase 1 SAT

I. Installation Testing

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

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

Table- 2-6 Fibre Optic System Installation Testing

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

Table- 2 -7 - Network Management Subsystem Installation Testing

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

II Pre-Commissioning Tests

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

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

Table -2-8 Fibre Optic Network Field Communications Testing

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

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

2.5.2.2 Phase 2 SAT (Field Integrated System Test)

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

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

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

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

2.6 Guaranteed System Availability Test (GSAT)

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

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

2.7 GSAT Duration and Acceptance Deadline

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

2.8 General Conditions for GSAT

The duration of the availability test shall be 200 hours.

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

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

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

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

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

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

either manually or automatically.

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

2.9 Test Program for GSAT

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

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

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

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

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

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

2.10 Acceptance Conditions

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

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

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

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

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

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

2.14 MAINTENANCE SUPPORT

2.14.1 Contractor Maintenance responsibility During the Guaranteed Availability Period

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

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

2.14.2 Continuing Maintenance Concept

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

2.15 Spare Parts and Test Equipment

The following mandatory spares shall be supplied.

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

2.16 Miscellaneous Supplies

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

2.17 Maintenance support facilities in India

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

2.18 Support Services

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

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

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

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

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

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

2.19 Technical Support

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

2.20 Continued Module Maintenance Support Plan

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

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

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

2.22 DOCUMENTATION

2.22.1 General Documentation Requirements

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

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

2.22.2 Test Documentation

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

The test documentation shall include the following:

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

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

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

2.23 Drawings

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

2.24 Document Quantities

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

2.25 TRAINING:

The Contractor shall give training for six numbers of TANTRANSOCO'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.

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PART-II- SECTION III**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS(GTP) FORMS**

GTP Form 1

GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (SDH)

Manufacturer: Model #:

Seq.	Parameter:	Unit:	Particulars:
1.	Capacity Aggregate Bit-rate: CEPT E-1 Ports:	Mbps n x E1	
2.	Is higher order Multiplex in-built unit of SDH	Yes/No	
3.	Protection SDH = 1:1 APS E-1 Ports = 1:1 APS	Yes/No	

4.	Unprotected System Gain for BER 10^{-3} : BER 10^{-6} :	dBm	
5.	1 + 1 APS System Gain for BER 10^{-3} : BER 10^{-6} :	dBm	
6.	MTBF Unprotected: 1+1APS Protected:	Hours	
7.	Code Format:		
8.	List Optical Coupling options:		

GENERAL SDH FEATURES:

9. Remarks:

OPTICAL TRANSMITTER			
Seq.	Parameter:	Unit:	Particulars:
10.	Source (LED or Laser)		
11.	Source wavelength:	Nm	
12.	Source spectral width:	Nm	
13.	Mean launched power Maximum: Nominal:	dBm	
14.	Launch power during safety Power-down due to fibre break:	dBm	
15.	Stability (nominal power variation due to temperature and/or biasing):	%	
Date: Place: Seal: -continued- Signature: Name: Designation:			
Seq.	Parameter:	Unit:	Particulars:
16.	Source rise time:		
17.	Source estimated life span:	Hours	
18.	Source extinction ratio:		
19.	Low power alarm Threshold: field adjustable	dBm	
OPTICAL RECEIVER			
20.	Nominal receive signal strength:	dBm	
21.	Receiver Threshold BER 10^{-6} : BER 10^{-9} :	dBm	
22.	Receiver overload limit:	dBm	

23.	Spectral Bandwidth (3 Db point):	Nm	
24.	Digital Bandwidth:	Mbps	
25.	Signal-to-noise @ center wavelength: @ 3 dB points:		
26.	AGC range:		
SERVICE CHANNELS AND ORDER WIRE UNIT			
Engineering Orderwire			
27.	Omnibus calling available Describe:	Yes/No	
28.	Selected station calling available? Describe:	Yes/No	
29.	Signalling scheme Describe:		
30.	Tx/Rx level	dBm	
31.	Speech coding method & bit rate	Kbit/s	
32.	Distortion: Noise performance:	S/N	
PROTECTION SWITCHING			
Seq.	Parameter:	Unit:	Particulars:
33.	Switching modes available Auto? Manual? Remote/network management?	Yes/No	
Date:		- continued-	
Place:		Signature:	
Seal:		Name:	
		Designation:	
Seq.	Parameter:	Unit:	Particulars:
34.	Switching priority:		
35.	Tx switchover & switchback criteria:		
36.	Rx switchover & switchback criteria:		
Seq.	Parameter:	Unit:	Particulars:
37.	Inbuilt Mux (if applicable) switchover & switchback criteria:		
38.	Switch option mode & status indicators:		
PDH Multiplexer			
Voice channels			
39.	Are Service channel requirements specified met?	Yes/No	

40.	No. of VF Channels:	Ea	
41.	Pass band:	KHz	
42.	Subscriber side interface:		
43.	Input & Output level	dBm	
44.	Idle channel noise	dBmOp	
45.	Distortion:		

Data and Supervisory Channel

46.	No of data channels:	Ea	
47.	Interfaces/Connectors:		
48.	Data rates:	Kbps	
49.	List ITU-T Standards in compliance With:		
50.	Tributary bit rate (nominal):	Mbit/s	
51.	Tolerance in bit rate:	Ppm	
52.	Line code:		
53.	No. of ports:		

Date:	- continued-	Signature:
Place:		Name:
Seal:		Designation:

Seq.	Parameter:	Unit:	Particulars:
54.	Impedance of coax cable used for Input/Output port:	ohms	
55.	Type of Connector		
56.	Spare cable pairs?		
57.	Input jitter acceptance 100 Hz to 10 KHz: 10 KHz to 800 KHz:	UI (p-p)	
58.	Maximum output jitter in the absence of i/p jitter 100 Hz to 10 KHz: 10KHz to 800 KHz:	UI (p-p)	
59.	Jitter transfer characteristic:		

OUTPUT PORT			
60.	Line impedance Balanced: Unbalanced:	Ω	
61.	Test load impedance (Unbalanced):	Ω	
62.	Peak pulse amplitude (nominal $\pm$ tolerance):	V dc	
63.	Pulse width (nominal $\pm$ tolerance):	ns	
64.	Ratio of +ve & -ve pulses at the center of a pulse interval		
65.	Ratio of width of +ive & -ive pulses at nominal half Amplitude		
66.	Maximum insertion loss	dB	
INPUT PORT			
67.	Attenuation Char. of inter-connecting cable for digital signal presented at input port		
68.	Return loss (at 1.024 MHz)	dB	
69.	Admissible i/p signal attenuation	dB	
70.	Cable loss Equalization Range	dB	
71.	Maximum insertion loss	dB	
72.	Electromagnetic compatibility(List standards & severity levels)		
Date:		- continued-	Signature:
Place:			Name:
Seal:			Designation:
Seq.	Parameter:	Unit:	Particulars:
MECHANICAL AND ENVIRONMENTAL PARAMETERS			
73.	Number of chassis (including. DC/DC converters, O/W muldem etc.,) required for Unprotected Terminal: I: 1 Protected Terminal		
74.	Chassis Dimensions (L *W*H):	Cm	
75.	Chassis Weight:	Kg	
76.	Chassis mounting options:		
77.	Chassis clearance requirements Top * Bottom * Sides: Front Access: Rear Access:	M	
78.	Chassis colour and finish		

79.	Rack options available 19" ETSI? Yes/No Slim rack? Yes/No Others (specify)? Yes/No		
80.	Protection Class (IP Class):		
81.	Rack Colour and Finish:		
82.	Temperature range Guaranteed performance: Operation without damage: Storage/ transport:	°C	
83.	Relative humidity Minimum: Maximum:	%	
84.	Altitude Installed: Transport/storage:	M	
85.	Describe Ventilation requirements:		
86.	Describe dust proofing provisions:		

Date:
Place:
Seal:

Signature:
Name:
Designation:

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

Manufacturer:

Model #:

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

Date: Signature

Place: Name

Seal Designation

GUARANTEED TECHNICAL PARTICULARS for Optical amplifiers

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

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

Date:

Signature

Place:

Name

Seal

Designation

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

Manufacturer:

Model Name & #:

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

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

Date:

Signature:

Place:

Name:

Seal:

Designation

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

Manufacturer:

Model Name & #:

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

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

Date:

Signature:

Place:

Name:

Seal:

Designation

DETAILED TECHNICAL SPECIFICATION FOR ELECTRONIC PRIVATE AUTOMATIC EXCHANGE (EPAX)

1.0 SCOPE:

- 1.1 This specification provides for design, manufacture, inspection and testing before despatch of EPAX Exchanges for Communication application and for use in conjunction with the existing PLCC carrier sets and PDH Multiplexer.
- 1.2 The EPAX exchanges shall conform in all respects to high standards of engineering design, workmanship with latest state of art technology and latest revisions of relevant standards at the time of offer and the purchaser shall have the power to reject any work (or) material, which in his judgment is not in full accordance therewith. The material used for manufacture of the equipment shall be of best class and capable of satisfactory operation in tropics with humid atmospheric condition without distortion (or) deterioration.

2.0 STANDARDS:

- 2.1 Unless otherwise specified elsewhere in the specification, the Power Line Carrier Communication Indoor equipment along with accessories shall conform to the latest revisions and amendments thereof, of the following standards/Technical Particulars.

Electronic Private Automatic Exchange(EPAX) : As specified under Technical Particulars.

- 2.2 Equipment meeting with the requirements of other authoritative International standards which ensure equal (or) better performance than the standards mentioned above, shall also be considered. When the equipment offered by the supplier conforms to other standards, salient points of difference between standards adopted and the standards in this specification shall be clearly brought out in the offer.

3. ELECTRONIC PRIVATE AUTOMATIC EXCHANGE(FOR PLCC APPLICATION):

- 3.1 The Electronic Private Automatic Exchanges shall work as local private automatic exchange. It should be fully micro-processor based system with pulse code modulation/time division multiplexing principle.
- 3.2 The Electronic Private Automatic Exchange should be compatible for operation with Electronic Switching Devices at the farther end, having the common pulsing criteria as under.
 - a. Engage Pulse : 200 to 250 ms. ON
70 to 90 ms. OFF
70 to 90 ms. ON
 - b. Priority Pulse : -do-
 - c. Release Pulse : Greater than 800 ms and less than 1000 m sec.
 - d. Dialling Pulse : 50 ms ON and 50 ms OFF
 - e. Operating voltage : 48V DC $\pm$ 10% - 15%

f. Ringing voltage : 75V MIN.

3.3 The EPAX to be supplied against this specification should be of static version and co-ordinate with the existing exchanges. It should be compatible for connection to different versions of Power Line Carrier Communications sets in service.

3.4 The trunk line dialing system shall provide full automatic dialing between subscribers. The existing trunk number of each station consists of two digits and the subscriber number is of two digits. In the EPAX, facility for storing atleast all the **four/six** digits of dialed number should be provided. **The time taken for the discrimination of the station and passing on the call to the adjacent section should be kept to a minimum and the exact time shall be given.**

3.5 Provision shall be made for each subscriber and trunk to have selective access or bar to specific area and stations.

3.6 The entire static circuitry should be well shielded and earthed so that any kind of external EMI noise should not affect the performance. The power supply and other circuit should be well protected against high voltage surges and spikes normally encountered in input power supply.

3.7 The EPAX should have the following facility.

1. To bar selected subscribers from entering the communication trunk lines.
2. To bar selected incoming call from outer station to other outer station on selective basis.
3. to have free line selection.
4. The EPAX offered shall be designed for double (2)/treble(3) digit station number for discrimination and for onward transmission. **The EPAX in case of PLCC application should be capable to store and forward more than five digit at the lowest possible time. This shall be included in the Test Certificate.**
5. Dry contact output for monitoring the general alarms of the EPAX shall be provided for connection to the local/remote SCADA system. This

will be in addition to the alarms to be displayed in the EPAX itself. Both Audible and visual alarms shall be provided.

- 3.8 The racks and modules of EPAX shall be mounted in a compact steel cabinet. The drawing of the cabinet along with the arrangement of various modules etc., shall be submitted along with the equipments. The MDF shall be separately mounted with a length of 10 Mtrs. of cable.
- 3.9 The capacity of the EPAX shall be wired upto MDF but equipped for the number of subscribers and No. of trunks as follows (viz)

The EPAX shall be capable for easy expansions if required at a later date as detailed below:

<u>Proposed</u>		<u>Provision for future expansion</u>
8S/8T	atleast	16S/16T
16S/16T	atleast	32S/32T
48S/32T	atleast	64S/48T

Additional connector shall be provided for expansion so that by mere insertion of subscriber/Trunk module the capacity expansion can be achieved. Replacement of existing subscriber/Trunk module of lower capacity by a subscriber/Trunk module of higher capacity for achieving capacity expansion is not acceptable.

Additional Features for EPAXes of 16S/16T and 48S/32T configuration:

- 3.10 EPAX shall have a microprocessor and programmable at site. The software shall support both E&M signaling and CO Trunks. The EPAX shall be provided with universal ports wherein the subscriber line card and CO trunk cards can be inserted into any slots.
- 3.11 The software provided for EPAX shall be programmable to work as a combination of PLCC and CO trunks (or) as a network exchange on E&M (PSTN/VSAT/VHF) and shall be user friendly.

3.12 ISDN compatibility for the CO trunks may be offered as optional. For this EPAX shall support a minimum dialing of 16 digits at a time and a maximum of 20 digits.

3.13 **The EPAX is for real-time operation and trouble free operation without resetting the CPU often shall be ensured.**

GENERAL:

The Booklet containing the details of the EPAX shall contain a brief outline of operation, simple user friendly instructions for programming and maintenance. This shall enable the field engineer to understand, operate and maintain the system.

10 Years after sales service guarantee/supply of spare cards components etc., shall be assured and an undertaking in this regard may be submitted.

3.14 **TEST REQUIREMENTS:**

Since static version of PAX are to be tendered as per this specification, they should conform to the voltage withstand requirement as per clause 6.1.1 and 6.3. of I.S.9482-1980.

Since power supply circuits are connected with long lead in 48V batteries which are kept away from carrier rooms, the input circuits may experience transient voltage of short duration but of relatively high peak value. The EPAX shall be subjected to impulse withstand test and High frequency disturbance test as per clause 4.2 and 5 of I.S. 8666 - 1977. The tenderer should state whether the EPAX offered by them has been subjected to the above type test and proof for the same shall be enclosed.

Whenever the EPAX is reset the exchange shall become operational within the lowest time as its application is for real-time basis grid operation purposes.

TECHNICAL DATA OF EPAX

1. Subscriber lines : Wired for Maximum capacity
2. Trunk lines : Wired for Maximum capacity
3. Switching Network : 256 Port for Non-blocking switch.
4. Numbering scheme : Flexible numbering scheme.
5. Switching Technique : Digital Type (Details shall be given)
6. Max. loop resistance : 1200 ohm for subscriber lines
2400 ohm for Trunk lines.
7. Insertion loss : 4 db for line to line at 800 HZ.
0.5 db for trunk to line at 800 HZ.
8. Frequency Response : 300 Hz to 3400 Hz.
9. Cross Talk : More than 70 DB between 300 to 3400Hz
10. Ringing
 - Local ring : 1500 MS On/1500 MS Off.
 - Trunk ring : 400 MS On/200 MS Off.
400 MS On/2000 MS Off.
 - Ring back tone : 500 MS On/500 MS Off.
11. Tones
 - Local ring : 1500 MS On/1500 MS Off.
 - Trunk ring : 400 MS On/200 MS Off.
400 MS On/2000 MS Off.
 - Call back ring : 500 MS On/500 MS Off.
12. Alarms : Card level fault visual display and audible alarm.
13. Display : Line status.
System status.
Power Supply.
Faulty trunks.

Time.

14. Line Protection : Line fuse and surge protection on each subscriber line.
15. MDF : To be mounted separately with a length of 10 Mtrs. Cable.
16. Operating Power supply: DC 48V (+) 10% & (-) 15%
17. The Exchange if needed in future shall support Load Despatch feature and the subscribers at the remote end provided with a remote extension interface (RE I) through which the remote subscriber can be given eight dialing or lift and talk facility through the Exchange at Load Despatch Centre.
18. The Exchange also shall provision of operator consoles for use in future.

//*

ANNEXURE-III

GUARANTEED TECHNICAL PARTICULARS.

1. Name & Address of the Manufacturer :

2. Type/Model :
3. Type of technology :
4. Architecture used
(32/64 bit Microprocessor) :
5. Method of mounting cubicle :
6. Method of connection to external circuits:
7. Cable Entry :
8. Literature :
9. Operating temperature range :
10. Operating relative humidity :
11. Operating voltage with range :
12. Power requirement :
13. Numbering scheme :
14. Maximum number of trunk lines :
15. Maximum number of subscriber lines :
16. No. of trunk lines per card :
17. No. of subscriber lines per card :
18. Method of extending capacity :
19. Method of implementing and modifying :
scheme
20. Speech signal levels : 4 wire transmit level=
4 wire receive level =
21. Facility for expansion :
22. PSTN/VSAT/VHF compatibility for future :
applications.

TECHNICAL PARTICULARS for

MULTICORE CABLE 0.6 MM/4 PAIR/TELEPHONE CABLE 0.6 MM/1 PAIR

0.6mm dia. Annealed Tinned copper conductor, PVC insulated, colour coded, 2 cores twisted to form a pair, pairs laid up, Aluminium Mylar shielded with drain wire, melinex taped, over-all PVC sheathed, screened Telephone Cables conforming to I.T.D. Specification No.S/WS-113C.

Four pair Single pair

1.	Wire diameter	:0.6mm
2.	Dia. Over Insulation	:1.1mm
3.	Thickness of Insulation	:0.25mm (Max.).....
4.	Elongation.	
	a) Conductor	:15%
	b) Insulation	:150% at break
	c) Sheath	:150% at break.....
5.	Tensile Strength.	
	a) Insulation	:Min. 12.5 N/mm ²
	b) Sheath	:Min. 12.5 N/mm ²
6.	Colour of pairs	: As per Table-2 of I.T.D. Specification S/WS-113C.
7.	Laid up dia of pairs	: 4.5mm 2.2mm
8.	Mylar Tape	:13 micron
9.	Polythene Aluminium tape	:25 micron
10.	Drain wire	:7/0.15mm.....
11.	Dia.Over shielded cable	: 4.7mm 2.4mm
12.	Overall diameter (Max.)	: 6.3mm 3.5mm
13.	Thickness of sheath (Min.)	: 0.65mm 0.5mm
14.	Colour of sheath	:Grey
15.	Max. conductor resistance at 20° C	:64.0 Ohms/KM

- | | | |
|-----|--|------------------------------------|
| 16. | Dielectric strength
between conductors. | : 2KV rms at frequency of 50 HZ |
| 17. | Volume resistivity at 27° C | : Min. 1×10^{13} Ohms/KM. |
| 18. | Capacitance unbalance | : 250 P.F. Max.Per km. |
| 19. | Shrinkage Test | : As per Clause VIII of IS:5831 |
| 20. | Solder Test
Specification S/WS-113C. | : As per clause 11.20 of I.T.D. |

MANUFACTURER'S IDENTIFICATION:

The manufacturers identification shall be provided throughout the length of the cable and shall be by embossing the Trade Mark/Manufactureres name. In addition, the letters, "Tamil Nadu Electricity Board" should also be embossed in the outer sheath of the cable at two metre intervals.

TEST BEFORE DESPATCH

Each cable coil shall be subjected to the following tests:

I. TELEPHONE CABLE:

MECHANICAL:

PVC Outer Size (Overall)
PVC Thickness
Conduction Dia. with PVC
Conductor above Dia.
PVC Tape-Thickness over lap
Presence of Rip card
Presence of Drain Wire.

ELECTRICAL:

High voltage Test for 2 KV for 1 minute
Insulation Resistance.
Conductor Resistance.
Capacitance unbalance.

MECHANICAL PHYSICAL TEST:

Conductor Elongation
Insulation Elongation
Tensile strength of PVC and sheath
Shrinkage Test
Solder Test

The purchaser reserves the right to inspect the cables and workmanship during the period of manufacture and to be present during the testing of the cables.

DETAILED TECHNICAL SPECIFICATION FOR DIGITAL PROTECTION COUPLERS:

General:

The Digital Protection coupler to be used in 400 kV & 230 KV lines with distance protection scheme is permissive under reach scheme, single phase, single shot, auto re-closure scheme.

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

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

The protection coupler shall be provided with interconnecting/interfacing unit suitable for connection with protection relay. It shall be possible to test the operational reliability of the protection channel from both ends. Necessary test prints, push buttons and lamps shall be provided for this purpose. During healthy conditions of the line the test procedure shall not initiate any tripping command. However, if a genuine trip signal is received during the testing process, the test function shall be completely blocked and overridden. i.e., the trip signal must have absolute priority.

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

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

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

Counters shall be provided for counting Trip send and Trip receive commands.

The Protection Coupler shall be of Digital version.

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

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

The Protection coupler shall be software programmable.

Performance requirements:

a) Transmission time less than or equal to 12 mS.

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

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

Additional points:

All inputs and outputs shall be galvanically isolated.
 Cross connect and drop insert facilities for binary inputs shall be possible.
 Point to multipoint operation is required.
 8 binary signals per 2 Mbps channel.

Sl.No. (1)	DESCRIPTION (2)	Particulars (3)
1.	Digital medium	G.703 (2 Mbps)
2.	Transmission speed	2 Mbps.
3.	Communication interface	G.703 (2 Mbps) Co-directional interface.
4.	No. of commands transmitted	Eight commands simultaneously.
5.	Command input detail	Opto electronic input 24 V to 250 V DC , 1 msselectable 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)	< 12 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 12 ms) probability of Missing command	<1 x 10 ⁻⁵

	(Dependability).	
13.	b. False trip PUC (probability of unwanted command) (Security)	$> 1 \times 10^{-3}$
14.	Power consumption.	15 W Max.
15.	Whether technical pamphlets and drawing enclosed or not	Yes
16.	Compliance to Teleprotection standard IEC 60834.	Yes
18.	Compliance to IEC-61000 standards	Shall be compliant
19.	a. Programmable entirely with PC. b. Built in event recorder of 255 events with 1ms. Precision. c. Possibility of daily automatic link check.	Shall be possible. Shall be available. Shall be possible

BLANK

SCHEDULE OF GUARANTEED PARTICULARS

DIGITAL PROTECTION COUPLER.

Sl.No.	DESCRIPTION	PARTICULARS
1.	Name of the manufacturer	:
2.	Type of modulation	:
3.	Signalling system	:
4.	Guard frequency	:
5.	Tripping signals for line	:
	Line I.	
	Line II.	
6.	Transmitter output level and whether it can be varied.	: YES/NO- Normal - Max. - Min. -
7.	Output attenuator adjustable or not. If adjustable range and variation of level.	: Yes/No Normal- Min. - Max. -
8.	Receiver input level	:
9.	Input attenuator adjustable or not. If adjustable range and variation of level.	:Yes/No : Min- :Max-
10.	Input / Output impedance of the equipment.	:
11.	Receiver Relay output (Tripping contact voltage Rating, current rating, No. of dry relay contacts)	}
12.	Alarm relay output	
	Voltage rating	
	Current rating	
	No. of dry contacts.	:
13.	Command relay input	:
	Voltage rating	:
	Current rating.	:
	No. of contacts	:
14.	Power supply operation range	:
	a) Operating Voltage Range	:
	b) Operating Temperature Range	:
15.	Test facilities for local loop test and End to End test are provided or not.	:
16.	Visual and audible alarm provided or not	:
17.	Whether technical pamphlets and drawing enclosed Or not	:
18.	Transmission time (maximum)	:
19.	Performance under noise conditions.	
	a. Fail to trip PMC (max. actual transmission	

- Time less than 12 ms) probability of
Missing command (Dependability).
b. False trip PUC (probability of unwanted
command) (Security)

20. Power consumption. :
21. Any other particulars the tenderer may wish:
to furnish.

Name of the firm :
Signature of Bidder :
Designation & Seal :
Date :

&&&&&

13. TECHNICAL SPECIFICATIONS

OPTICAL LASER SOURCE METER

- | | |
|---------------------------|-------------------------|
| 1. wave length(nm) | : 1310 &1550 |
| 2. Emitter type | : LD |
| 3. Central wave length | : 1310±20nm & 1550±20nm |
| 4. spectral width | : 5nm |
| 5. output frequency(HZ) | : 270,1K,2K |
| 6. Outputpower | : -5dBm |
| 7. Adjustable range | : ±3dB,0.1dB/ step |
| 8. auto power off | : yes |
| 9. Back light | : yes |
| 10. operating temperature | : -10to 50°c |
| 11. storage temperature | : -20 to 70°c |
| 12. power supply | : 6v,2500mAh |
| 13. output stability | : |
- short term(15min)<±0.05Db@1310,1550nm
- Long term(8hours)<±0.1dB@1310,1550nm

14.Relevant IEC/EN/VDE standards.
 Standard accessories:
 FC/PC,ST/PC,SC/PC interchangeable connectors,
 Manual,
 Carrying bag,
 Battery,
 Software(CD with USB cable),
 AC/DC charger,
 Test report.

14. OPTICAL POWER METER

TECHNICAL SPECIFICATIONS:

1.Calibrated wavelength(nm)	: 850/1300/1310/1400/1550/1625
2.Detector Type	: InGaAs
3.Accuracy	: $\pm 5\% \pm 1\text{Nw}$
4.Resolution	: 0.01dB@-60 to +10dBm 0.1dB@-70 to -60dBm
5. Linearity	: $\pm 5\%$
6. Auto power off	: yes
7. Backlight	: yes
8. Reference value	:yes
9. Measuring range(dBm)	: -70 to +26
10. USB interface	: yes
11. Data storage	: yes
12. Wave length recognize	: yes
13. Tone detection(HZ)	: 270,1K,2K
14. Operating temperature	: -10 to 50 °c
15. Storage temperature	: -20 to +70 °c
16. Power supply	: 6VAC/DC 2500Mah
17.Relevant IEC/EN/VDI standards.	

Technical requirement of Instruments

1. Optical Splicing Kit/machine : 1 No.

Acceptable Make, model : Furukawa S178A Ver.2 with all features and functions enabled / Equivalent/ Advanced model.

2. Optical Time Domain Reflecto Meter (OTDR) :1 No.

Technical features required:

- a. Ultra long haul measuring capacity
- b. Transmit Power Should be equal to 5 dB
- c. Central Wave length : 1310/1550nm $\pm$ 20nm
- d. Laser safety class (21CFR) : Class1
- e. Distance measurement Range : upto380km (380km for HD and VHD modules)
- f. RMS Dynamic Range : 50 db
- g. Event Dead Zone : 6m
- h. VFL option OTDR module:635nm $\pm$ 15nm Class 2.21 CFR
- i. Lithium-ion Battery with minimum of 15 hrs battery operation
- j. PC Software for Report Generation
- k. Ports required : USB & Ethernets testing – 10/100/1000/1G/10G
- l. Dual Optical Spectrum Analysis feature required.
- m. Temperature Range: -20°C to 50°C
- n. Storage: -20°C to 60°C
- o. Input/Output:
 - RS232-C Centronics Interface
 - External Keyboard
 - Ethernet Interface(optional)
- p. Additional items required:-
 - i) Visual Band Locator
 - ii) Laser Source & Power Meter features enabled.
 - iii) Video Inspection Probe

Acceptable Make, model: VIAVI 8100D series or equivalent and all Other advanced features and functions enabled

3. Optical Power Meter: 1 No. Preferred Make: JDSU.

4. Optical Power Source: 1 No.

The Optical Fiber Splicing Tool Kit comprising the following items shall be supplied along with the splicing machine.

Sl.No.	Name	Qty.
1	High precision fibre cleaver	1 No.
2	Pocket visual fault locator	1 No.
3	Electrodes	1 pair
4	Mechanical optical fibre splicer	1 No.
5	Multi-purpose Screw driver Pack	1pack
6	Skid-resistant Scissor	1 bar
7	Fiber Stripper	1 bar
8	Fiber Transverse Cable Cutter	1 bar
9	Steel Wire Pliers	1 bar
10	Slotted Bits	1 bar
11	Cross Point Screwdriver	1 bar
12	Optical tube stripper	1 bar
13	Mini Handsaw	1 bar
14	Saw Blade (Backup)	3 Nos.
15	5M Tape	1 No.
16	Tweezers	1 set
17	Flat Nose Pliers	1 bar
18	Cutting Pliers	1 bar
19	Alcohol Pump	1 set
20	Marker	1 No.
21	Knife	1 bar
22	Tool Box	1 No.
23	Durable field carry bag	1 No.

Optical time domain reflecto Meter :

To supply Optical time domain reflecto Meter with high dynamic range of 50/48 dB.

SECTION – 3

PROEJCT DETAILS & GENERAL TECHNICAL REQUIREMENT

3.0 FOREWORD

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

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

- a) Customer : M/s Tamil Nadu Transmission Corporation Limited
- b) Project Title : 400/230-110 kV Substation at Vellalaviduthi
- c) Transport facilities : Road/Rail

Physical and other parameters:

- 3.1.1 Location of the substation : Vellala viduthi, Pudukottai district
- 3.1.2 Nearest Railway station : Pudukottai
Railway : Southern Railway
- 3.1.3 Meteorological data
- (i) Maximum ambient temperature : 50°C
 - (ii) Minimum ambient temperature : 20°C
 - (iii) Maximum daily average ambient air temperature : 45° C
 - (iv) Maximum yearly average ambient air temperature : 32° C
 - (v) Maximum Humidity (%) : 100%
 - (vi) Average thunder storm days per annum : 50
 - (vii) Average rainy days per annum : 90
 - (viii) Average annual rainfall (mm) : 1000 mm
 - (ix) No. of months during which tropical monsoon condition prevail : 5
 - (x) Maximum wind pressure : 150 Kgf/Sqmm
 - (xi) Altitude above MSL : 1000M

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

MAIN ELECTRICAL PARAMETRS:		
a)	Fault Levels	400kV: 63kA for 1 sec. 230kV: 40kA for 3 sec. 110kV: 40kA for 3 sec.
a)	Creepage Distance	25mm/kV

3.1.4 AUXILIARY POWER SUPPLY :

Auxiliary electrical equipment's, maintenance equipment's etc., shall be suitable for operation on the following supply system.

3 phase AC Supply	415V, 3 phase 4 wire, 50 Hz, neutral grounded AC supply -10% to +10%, Frequency +/- 5%
1 phase AC supply	240V, single phase, 50 Hz, neutral grounded AC supply -10% to +10%, Frequency +/- 5%,
DC supply	220V, 2 wire DC supply + 10% to -15%, Ungrounded 48V, 2 wire DC supply , Positively earthed

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.0.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardwares, insulators, bus bar. These designs/ drawing shall be got approved by the purchaser before commencing the manufacture/ construction/ erection and are to be as per latest IS/ IEC.

3.2.2 GENERAL:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section-1 of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT

The bidder shall furnish make/manufacturer, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standards specified in the specification.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.5 TEST CERTIFICATE:

Copies of all test certificates relating to material to be procured by the contractor for the works shall be forwarded to the OWNER.

3.6 TESTS :

All the tests as per relevant IS/IEC shall be carried out.

3.7 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate IS/IEC.

The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipments should operate without undue vibration and with the least practicable amount

of noise.

3.8 INSPECTION :

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL , reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller, provided rerolling of structural steel section is done from billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly.

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.

The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.9 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.10 PRE COMMISSIONING TESTING (if applicable) :

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO/ BHEL and the bidder for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.11 DOCUMENTATION :

All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.12 PAINTING, GALVANISING :

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5**.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre**. Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard. The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.13 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a

suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.14 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 a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.15 FUNGI-STATIC VARNISH

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

3.16 DEGREE OF PROTECTION

The supplier shall propose following Degree of protection for those equipment/Items for which the degree of protection has not been specified in the specification for the approval of BHEL/TANTRANSCO. The decision of BHEL/TANTRANSCO shall be final. The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes, panels etc to be installed shall provide degree of protection as detailed here under:

- a) Installed outdoor: IP-55
- b) Installed indoor in air conditioned area: IP-42
- c) Installed in covered area IP:52
- d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS: 13947 (Part-1)/ IEC-60947 (Part-1)/ IS 12063 / IEC-60529. Type test report for degree of protection test on each type of the box shall be submitted for approval.

3.17 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these

specifications and documents.

3.18 RATING PLATES, NAME PLATES AND LABELS :-

The equipments shall be provided with a rating plate or plates marked with but not limited to following data whatever needs to that particular equipments (as applicable).

- (a) Manufacturer's name or trade mark.
- (b) Serial number and type design making it possible to get all relevant information from the manufacturer.
- (c) Year of manufacture.
- (d) Rated voltage
- (e) Rated insulation level.
- (f) Rated frequency
- (g) Rated Normal current.
- (h) Rated short circuit breaking current
- (i) First pole to clear factor
- (j) Rated duration of short circuit
- (k) Rated auxiliary D.C. supply voltage of closing and opening devices.
- (l) Rated pressure of SF6 gas for operation and interruption.
- (m) Rated out of phase breaking current.
- (n) Rated supply voltage of auxiliary circuit.
- (o) Rated supply frequency of auxiliary circuits.
- (p) Purchase Order Number and Date.

The rating plate shall be visible in position of normal service and installation. The rating plate shall be weather proof and corrosion proof.

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the BHEL/TANTRANSCO. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments 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. During approvals drawings of Rating/name plates/labels shall also be submitted.

3.19 TERMINAL CONNECTORS :

The terminal connectors shall meet the following requirements.

- a. Terminal connectors shall be manufactured and tested as per IS : 5561.
- b. All castings shall be free from blow holes, surface blisters, cracks and cavities.
- c. All sharp edges and corners shall be blurred and rounded off.

- d. No part of a clamp shall be less than 10mm thick.
- e. All ferrous parts shall be hot dip galvanized conforming to IS: 2633.
- f. For bimetallic connectors, copper alloy liner of minimum thickness of 2mm shall be cast integral with Aluminium body. Flexible connectors shall be made from tinned copper.
- g. All current carrying parts shall be designed and manufactured to have a minimum contact resistance.
- h. Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS : 5561.
- i. Terminal connectors shall be for Twin Moose Conductor with a spacing of 450mm between the conductor.

3.20 EARTHING :

The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50x8mm mild steel flat to be provided for connection to station earth mat.

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat of Size 75x12 mm. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.21 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers. Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm.copper flexible.
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All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible.
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The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment. TB sizes for incoming power supply shall be informed/confirmed during drawing approval stage.

3.22 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled Neoprene /EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof

and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

3.23 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater. One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

3.24 DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:

Delivery of goods shall be made by the supplier in accordance with the terms specified by the BHEL in its schedule of requirements.

3.25 INCIDENTAL SERVICES:

The Supplier is required to provide any or all the services broadly outlined in the Technical specification. Any other minor incidental service related to the scope of work like providing necessary assistance whether specifically mentioned or not must be carried out by the Supplier at his own cost. All tools, Tackles Plant etc., required for completion of above works shall be brought by the Supplier.

3.26 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/TANTRANSCO 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/TANTRANSCO shall be final and binding on the Supplier.

3.27 LIST OF DRAWINGS AND DOCUMENTS :

The drawings for the equipments provided by the TANTRANSCO/BHEL shall be followed strictly by the bidder while designing. For the rest of the equipments, the design is in the scope of the bidder and the same got approved by the TANTRANSCO/BHEL.

The bidder shall furnish one set of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the Offer (as applicable). (Drawings, GTP, type test reports, list of past supplies etc. Drawings & documents submitted at the time of offer shall be subject to review at contract stage)

- (i) General outline drawings showing dimensions and shipping weights, quantity of insulating media, etc.
- (ii) Sectional views showing the general constructional features of the equipment (eg. Breaker drg includes operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance).
- (iii) Schematic diagrams of equipment (eg. Breaker drg includes for control supervision and re-closing.)
- (iv) Structural drawing, design calculations and loading data for support structures.
- (v) Foundation drilling plan and loading data for foundation design.
- (vi) The Type Test Reports
- (vii) Bill of materials shall be furnished along with drawings.

The supplier shall, within 1 week of placement of order submit six sets of final version of all the above drawings for TANTRANSCO/BHEL approval. The TANTRANSCO/BHEL shall communicate its comments/approval on the drawings to the supplier within reasonable period. The Supplier shall, if necessary, modify the drawings and resubmit six copies of the modified drawings for TANTRANSCO/ BHEL approval within one week from the date of comments. After receipt of TANTRANSCO/BHEL approval, the supplier shall, within two weeks, submit 8 prints and two good quality reproducible of the approved drawings for TANTRANSCO/BHEL use. However the drawing approval does not absolve the supplier from complying with the terms of the specification.

The following should be supplied to each consignee circle along with the initial supply of equipments ordered.

- 1) Five copies of printed and bound volumes of operation, maintenance and erection manual in English along with the copies of approved drawings and type test reports etc.
- 2) Three sets of manuals detailed in item (1) shall be supplied to the TANTRANSCO/BHEL within one week from the date of approval of drawings.
- 3) The spares for the Equipment's ordered under the scope of the Contract should also be supplied to the consignee circle along with initial supply of the equipments.
- 4) It should be noted that if the above conditions are not fulfilled the initial payment will not be released.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the TANTRANSCO/BHEL 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.

Following Documentation schedule to be followed

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	6	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	6	10	

4	Erection Manuals	-	6	10	
5	Operation and Maintenance Manuals	-	6	10	
6	Manufacturing Quality Plan	-	6	10	
7	Field Quality Plan	-	6	10	
8	Inspection Test Reports	-	6	10	

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later 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.

3.28 QUALITY ASSURANCE PLAN :

The bidder shall invariably furnish following information along with his offer.

- (i) Statement giving list of important raw materials including but not limited to:
 - (a) Contact material
 - (b) Insulation
 - (c) Porcelain
 - (d) Sealing material
 - (e) Contactor, limit switches, etc. in control cabinet.

Name of sub-supplier for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representative, copies of test certificates.

- (ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- (iii) List of areas in manufacturing process, where such inspections are normally carried out for quality control and details of such tests and inspections.
- (iv) Special features provided in the equipment to make it maintenance free.
- (v) List of testing equipment available with the Bidder for final testing of equipments vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

The supplier shall submit following information to the TANTRANSCO/BHEL.

- 1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- 2) Type test certificates of the raw material and bought out accessories.
- 3) Quality assurance plan (QAP) withhold points for TANTRANSCO/BHEL inspection. The quality assurance plan and hold points shall be discussed between the TANTRANSCO/BHEL and supplier before the QAP is finalized.

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled equipment.

3.29 TEMPERATURE RISE :

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of the sun shall not exceed 30(/25) deg. C over an ambient of 45(/50) deg. C limits specified in relevant IEC. When the standard specify the limit of temperature rise these shall be exceeded when corrected for the difference between ambient temperature at site and that specified in the approved specifications.

No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

3.30 FITTINGS AND ACCESSORIES :

Following is a partial list of some of the major fittings and accessories to be furnished by contractor as an integral part of the equipment.

Operation mechanism housing complete with:

- (a) Locking arrangement.
- (b) Heaters equipped with automatic thermostatic control and control switch.
- (c) Cable glands.
- (d) Local/Remote change over switch.
- (e) Operation Counter.
- (f) Terminal Blocks.
- (g) Control switches to cut off control power supply.
- (h) MCCBs/MCBs are required with permanent identification marks for protection of D.C. circuits and A.C. circuits.
- (i) Two earthing terminals.

3.31 PACKING AND FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal Transport, as the case may be and suitable to withstand handling transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their final destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' final destination and absence of heavy mechanized handling facilities, at all points in transit.

The packing, marking and documentation within and outside the package shall comply strictly with

such special requirements as shall be expressly provided for in the Contract or in any subsequent instructions issued by BHEL.

3.32 SPECIFICATION FOR NITRYL BUTYL RUBBER

The gaskets are to be used in tanks exposed to Transformer mineral oil/SF6 at about 110° C.

1. Hardness should be Shore A 70 ± 5 .
2. Tensile Strength should be min. 10.8N/sq.mm (Minimum)
3. Elongation strength should be 270% (Minimum)

AFTER AGEING

1. Change in weight should not be more than 10% and change in Hardness should not be more than Shore A ± 10 after 7 days aging in transformer oil.
2. There should not be any visible damages after accelerated aging of 24 hours in transformer oil of temperature 110° C.

CHECKLIST FOR TECHNICAL EVALUATION

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.	

The above checklist is verified for:-

Name of Bidder :

Date

TECHNICAL REQUIREMENT OF PQR

Name of Project:- 400/230-110 kV Substation at Vellalaviduthi for TANTRANSCO

Name Of Item :- Fibre Optic Telecommunication System

Doc. No: TB-399-510-121 Rev00

Sr. No	Description	Supporting Document to be attached								Reference No. of supporting documents																
A)	Cl. No. 1.3 of Section-1 of TS																									
01	The bidder should have designed, tested, supplied and commissioned OLTE equipments for 400kV system or above to Electricity boards/ Power utilities in India during the last Ten (10) years and the same should have been in satisfactory operation(#) for a minimum period of Two years as on date of technical bid opening ie. 21/08/2017. (#) Satisfactory operation means certificate issued by the Customer certifying the operation without any adverse remark.	a) Bidder to provide confirmation of fulfilling Technical Requirements mentioned in Cl. No. 1.3 of Section-1 of TS. b) Purchase Orders The details are to be submitted in following format, <table><tr><th>Sr. No</th><th>ITEMS SUPPLIED TO</th><th>ORDER REFERENCE No. & DATE</th><th>ITEMS</th><th>QUANTITY</th><th>ORDER FULLY EXECUTED. YES/NO</th><th>STATUS, IF ORDER UNDER EXECUTION</th><th>REMARK</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> c) Dispatch Instructions/ Material Receipt at site certificate/ Lorry Receipt details etc d) Letter/ Certificate/ MOM from customer/ end user for satisfactory operation								Sr. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED. YES/NO	STATUS, IF ORDER UNDER EXECUTION	REMARK									a) b) c) d)
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