POWER GRID COMPANY OF BANGLADESH LIMITED

Single-Stage Two-Envelope
Bidding Procedure

BIDDING DOCUMENT

FOR

Design, Supply, Installation, Testing & Commissioning of High Capacity Telecommunication Transmission Equipment for Several Locations to Connect Dhaka-Benapole-Kuakata on Turnkey Basis.

(Contract No: PGCB/OPGW/DHK-KKT)

VOLUME 2 OF 3

Issued on: January 27, 2020
Invitation Letter for Bids No.: 27.21.0000.101.07.215.20.546
ICB No.: PGCB/OPGW/DHK-KKT]
Employer: Power Grid Company of Bangladesh Limited
Country: People's Republic of Bangladesh

JANUARY 2020

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Scope of Works and General Information

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SECTION 1

Scope of Works and General Information

1.1 General

Power Grid Company of Bangladesh (PGCB) Limited is going to construct a high capacity optical fiber transmission network covering several important locations of Bangladesh in order to bring the transmission capacity from Kuakata SMW-5 Submarine cable landing station as well as Benapole ITC Operator's POP and distribute the transmission capacity to several important locations. The scope of the works under this tender is to deploy high capacity (100G) DWDM optical transmission equipment, Optical Line Amplifiers (OLA) and associated auxiliary equipment at different locations of Bangladesh.

The following include (but not limited to) a brief description of the scope of works, and details are described in the subsequent sections of the Bidding Documents.

i) Conduct site survey and finalize the network diagram (if required).

ii) Design, Supply, Installation, Testing and Commissioning of Telecom Equipment, NMS and AC/ DC Power system accessories.

iii) Design, Supply, Installation and Commissioning of (6 feet x 6 feet) Glass Enclaved Partition for Equipment with all the standard facilities (Air Conditioner, Power System Supply, and Lighting)

iv) Supply and Intallation of Grounding System at all the required sites (Earth Resistance must be <1 ohm).

v) Supply and Installation of ODF and arrange all the required materials of ODF to ODF (Patch Cable) and ODF to Equipment Connectivity.

vi) Supply of Test Equipment (OTDR, Splicing Machine, Digital Optical Power Meter etc.) and all required software for NMS and Client.

vii) Transportation service during the project period.

viii) FAT/PSI/PLI, Local and Foreign Training (at Manufacturer's premises).

ix) Guarantee for at least 02 (Two) years and Annual Maintenance Contract (AMC) with the Bidder/ Manufacturer for at least 03 Years.

1.1.1 Summary of the Scopes of procurement in the contract

The total scope of procurement of different equipment as per site wise requirement is as follows-

Classification	Number and Location
Reconfigurable Optical Add Drop Multiplexer (ROADM) DWDM equipment	08 (Eight) Sites. Patuakhali, Barisal 132, Khulna Central, Jessore, Ishwardi 230, Sirajganj 230, Rampura S/S of PGCB and Ashuganj Power Station.
Reconfigurable Optical Add Drop Multiplexer (ROADM) DWDM equipment with (With Traffic Add drop)	04 (Four) Sites. Bheramara 230, Gulshan, Benapole, of PGCB, Kuakata Landing Station (BSCCL).

Optical Line Amplifier (OLA) equipment	10 (Ten) Sites. Bagerhat, Satkhira, Jhenaidah, Madaripur, Faridpur, Bogra 132, Shahjadpur, Tangail, Kaliakoir, Maona (Tower), S/S of PGCB
NMS and INMS for DWDM (With Server & Monitor)	01 (One) set in PGCB HQ, Aftabnagar, Dhaka.
DC Power system (Rectifier & battery)	22 (Twenty-Two) sets of system.
Inverter/UPS	01 (One) Set at Aftabnagar, Dhaka.
Test Instrument	01 Lot
Air Conditioner (2 Ton Split)	44 (Forty-Four) Sets.
Optical Distribution Frame	05 (Five) Sets.
Optical Fiber, Pigtel and Patch Chords	As Per Requirement.

The present and future requirements of different services of the DWDM equipment at various sites are given in **Annexure 2** and **Annexure** 4, respectively. Unless otherwise described in the Technical Specifications, the scope of provision shall cover survey, designing & drawing, supplying, in-stalling, testing and commissioning of equipment and materials and related facilities on “Full Turn-Key” basis. Detail Technical Specifications are given in other sections of this document.

1.1.2 Summary of the Scopes of Electro-Mechanical Works in the contract

The total scope of procurement of different electro-mechanical works as per site wise is as follows-

i) The Bidder will supply all the required cards and ancillary materials/parts that will be used in order to commission DWDM equipment.

ii) The Bidder will supply all the required power cables (AC/DC) and ancillary materials/parts for DWDM Rack/Battery/ Charger/ Rectifier etc.

iii) The bidder will be liable to supply grounding bar and conductor with ancillary materials to ensure proper grounding to all DWDM Rack/ Equipment.

iv) The bidder will be liable to provide attenuator of different ratings (5 dB/ 10 dB/15 dB etc.) to the required connectivity ports as per requirement of Schedule A, Volume 3.

1.2 Maintenance Spares for buffer stock

a) The Bidder shall quote the “Maintenance spares” with a detail list for the quoted “Maintenance Spares” to be maintained as a central buffer stock by PGCB which will be sufficient for running the system for 3 (three) years from the end of guarantee period.

b) The list must include the following;

i) At least one unit of each replaceable item for each type network element (Common Module/Interface Module)

ii) For NMS/CIT equipment there is no need to quote any spares.

iii) Number of units may be more depending upon the size of the node and MTBF of the critical equipment/components.

c) The quotation for such list (in Schedule B6) is mandatory and failure to quote shall be regarded as "non-compliance" and it shall be considered that the bidder proposes to supply any quantity of spares, as fixed up by PGCB during contract negotiation, "**free of charge**" to PGCB.

1.3 Spare parts and consumables used before the end of Guarantee Period

All necessary spare parts and consumables used during installation, testing & commissioning and operation of the equipment, up to the end of Performance Guarantee Period, shall be quoted in Schedule B of Volume 3. Any spares needed beyond this shall be supplied by the Bidder at his own cost.

1.4 Guarantee Period

i) The bidder's offer shall include an overall **"Guarantee Period"** for the whole system covered by this purchase. This period shall deem to have started from "the date of effect" of each PAC of the contract and last for 02 (Two) calendar years.

ii) During the period of this Guarantee, the bidder shall offer all material, equipment, services and Maintenance support as described in relevant clauses for Spare Parts and "Maintenance Support up to Guarantee Period".

iii) Individual Guarantee mentioned for individual products by the bidders (Battery/ Charger/ Air conditioner etc.) will prevail also as per declaration and PGCB requirements.

1.5 Documentation

Refer to Schedule I of Volume 3

Bidder shall include in his offer prices for these Documentation. Failure to quote
Shall be considered that the bidder proposes to provide this **"free of charge"** to PGCB.

Any disagreement will be treated as "**Major Deviation**".

1.6 Quotation for additional equipment

If the bidder thinks that any additional equipment, not listed in this document, is needed for proper implementation and subsequent O&M of the proposed equipment, he shall quote for such equipment. If any such equipment is not quoted, it shall be deemed that no additional equipment is necessary for proper implementation and subsequent O&M of the proposed system. If during implementation and subsequent O&M up to guarantee period, either the bidder or the purchaser finds that any additional equipment are obligatory for proper implementation and subsequent O&M of the network, the bidder shall be liable to supply such systems or equipment, whatever be the required quantity, "**free of charge**" to PGCB.

1.7 Quotation for Optional Items

The bidder shall quote for all of the optional items as per Schedule-B. Bidder shall note that such quotation is mandatory but price quoted in Schedule-B will not be considered for financial evaluation.

1.8 Unit Price for Future Orders

i) The unit prices for all future orders for all equipment and services covered by this purchase shall be equal to or below the prices quoted in the original contracted offer.

ii) The Bidder shall quote, with his offer, a detailed 'Future Order Formula' separately for equipment and services in Schedule-B and submit in the Financial Documents.

iii) The new prices as per quoted future order formula shall become effective only for orders placed after Guarantee Period and up to 8 years of the life time of all equipment and services as per BOQ under this purchase.

iv) All parameters of the quoted formulae must be described clearly.

1.9 Possibility of change in Scope of Work and BoQ

The Bidder shall note that the tender document has been prepared based on a preliminary survey of the prevailing infrastructure and facilities in PGCB. During BOQ finalization with the successful bidder, the proposed network design may be changed depending upon the actual requirement at that time and based on that finalized network design the size, number, location etc. of different equipment may also be changed accordingly, even some item(s) may be dropped but total Bill of Quantities (BoQ) prices shall be within the amount in purchase proposal approved by the competent authority.

1.10 Omission of any Mandatory Items in the Contracted BoQ

The bidder shall note that, even if any or many work(s), equipment or service(s) mentioned in this document as mandatory, is not mentioned in the contract BoQ for any reason, the bidder shall not be automatically relieved of his responsibility for those items. But if such omission(s) has (have) previously been agreed, in writing, by PGCB's BoQ team, the bidder shall not be made liable for such omitted items. Such approved omissions, if any, shall have to be put either into the contract document or into any other document which subsequently is declared as part of the contract.

1.11 Prevalence of different clauses, sections and books

If, for any item, the contents of a Clause of any Volume contradict with the contents of any other Clause of the same or other Volume of the Tender Document, the prevalence of the Clause shall be as follows:

i) In case of different Volume, Volume Two shall supersede Volume One;
ii) In case of same Volume, later Section shall supersede previous Section;
iii) In case of same Section, later Clause shall supersede previous Clause.
iv) In case of later corrections by PGCB, corrections shall prevail with its due position.

1.12 Deviations from PGCB's requirements

The bidder shall note that, during submission of the bid, if he does not comply to any or many requirement and/ or specification and/ or terms or conditions set forth in this document or proposes any alternate specification and/ or terms and/ or conditions; such non-compliance and/ or alternate specification and/ or terms and/or conditions shall not be binding upon PGCB until and unless such non-compliance and/or terms and/or conditions have been incorporated in writing in the Purchase Contract.

1.13 The Proposed Network Architecture

The proposed architecture of the Network is shown in **Annexure 1.**

1.14 Obligation to follow the Scope of Works

The Bidder shall note that all the items of Equipment/Materials and Services mention in this section are mandatory unless any item is mentioned as optional. Bidder must agree all the mandatory items of the Scope of Works.

1.15 Technical and Financial Documents to be submitted with the offer

Refer to BDS (Section 2, Volume 1)

1.16 Mandatory Documents

Refer to BDS (Section 2, Volume 1)

1.17 Factory Acceptance Test (FAT)

The Bidder will be liable to arrange 02 (Two) Factory Acceptance Test for DWDM equipment and Battery with Charger/Rectifier separately which will be of at least 07 (seven) Working Days excluding Travel Time. Details of FAT are given Section-7 of this Volume 2.

1.18 Training at Manufacturer Premises

The Bidder will be liable to arrange a training at manufacturer's premises for PGCB officials for Operation and Maintenance of DWDM equipment and Battery with Charger separately which will be of at least 10 (Ten) Working Days excluding Travel Time. Details of FAT are given Section-7 of this Volume 2.

1.19 Detailed Scope of Works

Refer to Schedule-A of Volume 3 of 3

SECTION 2

TECHNICAL REQUIREMENTS FOR TRANSMISSION NETWORK EQUIPMENT

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SECTION 2

TECHNICAL REQUIREMENTS FOR TRANSMISSION NETWORK EQUIPMENT

2.1 SCOPE

This section of the Technical Specification describes the general requirements for all equipment being supplied under the Contract, electrical aspects being covered in another Section of the Specification. It shall be read in conjunction with the General Conditions, Drawings, the Schedules and other sections of the Technical Specification covering particular aspects of the plant and in the event of conflict between the General and Definite Contract Requirements, then the latter shall take precedence.

The Goods and Related Services shall comply with following Technical Specifications.

2.1.1 INTRODUCTION

This Section describes the technical specifications for Optical Fiber Platform of Dense Wavelength Division Multiplexing (DWDM) technology (DWDM equipment) operating at discrete wavelengths in the C-band centered around 193.1 THz frequency as per ITU-T Rec. G.697.1 grid, at 50GHz/100 GHz channel spacing. The DWDM system shall have 100 Gb/s transmission on line side or higher bandwidth per channel in the C-band. The 10GE and 10Gbps shall be supported simultaneously on the client side with no changes to the common equipment at the optical layer.

The Specifications in this section covers the technical requirements of Optical Fiber Platform of Dense Wavelength Division Multiplexing (DWDM) technology (DWDM equipment) on single mode optical fibers conforming to ITU Rec. G. 652D. The key requirement is to transmit bandwidth efficiently that can be achieved with WDM deployments considering the following requirements:

i) High capacity transport.
ii) 10 Gbps / 10 GE / 100 GE Multiplexing and grooming capabilities
iii) End to End transparency
iv) Without requirement of any Regeneration of line signal (Minimum 100G per lamda) in between Source and destination node (Anywhere in between the Main, Protection and restoration paths).
v) Without requirement of using any Dispersion Compensation module.
vi) Capable of implementing Protection and Restoration mechanism using Layer 0 (L0)- ASON/GMPLS/Optical ASON for increased service availability and decreased downtime.
vii) Having inbuilt OTDR functionality.
viii) Same Type/Unique type of 100G Line Card should be offered in this Tender.
ix) Same Type/Unique type of 100G Client Card should be offered in this Tender.
x) Same Type/Unique type of 10G Client Card should be offered in this Tender.
xi) Same Type/Unique type of centralized switching Card should be offered in this Tender.
xii) Same Type/Unique type of WSS Card should be offered in this Tender.
xiii) Same Type/Unique type of OTDR Function Card should offered in this Tender.
xiv) OLA Backplane/Shelf/Chassis should be same as ROADM Backplane/Shelf/ Chassis so that in future 100G Line Card, 100G Client Card, 10G Client Card, WSS Card, etc can be inserted. OTDR Function Card must be inserted in OLA system.
xv) Necessary software with license for all cards/modules/ hardware.

Any disagreement/deviation will be treated as “**Critical Deviation”**.

2.2 DWDM System

2.2.1 ITU-T and IEEE Recommendations

The DWDM equipment/system shall conform to the following ITU-T and IEEE Recommendations. The latest version of ITU-T and IEEE Recommendations at date of contract signature will also be considered.

i) G.661 'Definitions and test methods for the relevant generic parameters of optical amplifier devices and subsystems'
ii) G.662 'Generic characteristics of optical amplifier devices and subsystems'
iii) G.663 'Application related aspects of optical amplifier devices and subsystems'
iv) G.667 'Characteristics of adaptive chromatic dispersion compensators'
v) G.671 'Transmission characteristics of optical components and subsystems'
vi) G.672 'Characteristics of multi-degree reconfigurable optical add/drop multiplexers'
vii) G.681 'Functional characteristics of interoffice and long-haul line systems using optical amplifiers, including optical multiplexing'
viii) G.691 'Optical interfaces for single channel STM-64 and other SDH systems with optical amplifiers'
ix) G.692 'Optical interfaces for multichannel systems with optical amplifiers'
x) G.693 'Optical interfaces for intra-office systems'
xi) G.697.1 'Spectral grids for WDM applications: DWDM frequency grid'
xii) G696.1 'Longitudinally compatible intra-domain DWDM applications'
xiii) G.709 'Interfaces for the optical transport network '
xiv) G.783 'Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks'
xv) G.798 'Characteristics of optical transport network hierarchy equipment functional blocks'
xvi) G.806 'Characteristics of transport equipment - Description methodology and generic functionality'
xvii) G.957 'Optical interfaces for equipment and systems relating to the synchronous digital hierarchy'
xviii) G.8251 'The control of jitter and wander within the optical transport network (OTN)
xix) IEEE 802.3ba 'Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gb/s and 100 Gb/s Operation'
xx) IEEE 1588 V2 'Precision Time Synchronization;
xxi) G 8275.1 'Phase Synchronization Switching'
xxii) G.8080/Y.1304 'Architecture for the automatically switched optical network'
xxiii) RFC 3945 'Generalized Multi-Protocol Label Switching (GMPLS) Architecture'

Apart from the aforementioned standards, the manufacturer of DWDM system will have to fulfill the other standards (mentioned in another part of this document) as well. Any disagreement/deviation of each of the above recommendations will be treated as **"Critical Deviation"**.

2.2.2 Basic Requirements for DWDM system Design

Bidder will quote the DWDM equipment for all the ROADM and OLA nodes complying technical specifications specified in this Section 2 and will design as specified below-

a) Each node will be equipped with:

i) At least 80/96 or higher OCh Mux/Demux.
ii) Required no. of WSS (4 Port or higher), Amplifier, OSC, OPS etc. equipped in optical sub-racks.
iii) Required no. of Line cards (Transponder), Client cards, OTN Switch (If used) equipped in same optical sub-racks or separate sub racks.
iv) Required no. of cards/hardware for OTDR functionality.
v) No Raman board for long transmission.
vi) Necessary software with license.
vii) All sub-Rack must have power and controller redundancy.
viii) Initially Electrical ASON (Will use Optical ASON when required).
ix) OTN switch (If used) must have redundancy.
x) Line and Client ports must be on separate cards.

b) The offered DWDM equipment must be equipped in one equipment rack with all necessary hardware and software with license to provide line side protection and restoration facility (if fiber link available) through fiber connectivity given in Annexure-1 and Annexure-3, entitled Network Topology and Distance and dB Loss, respectively. The offered equipment must have the switching capacity to meet up the requirement of Annexure-2 and Annexure 4, respectively, along with the consideration of additional two times capacity (mentioned in Annexure-2 and Annexure 4) expansion with Electrical/ Optical ASON in nearby future. Cost of any sorts of additional lamda/card/hardware license shall be deemed into the contract.

c) The offered Line card/Transponder should have reach, Dispersion Tolerance, OSNR to travel through the longest possible path/link so that no regeneration of line signal in between Source and destination node of traffic (Anywhere in between the Main, Protection and restoration paths) is required in all possible Restoration scenario and no dispersion compensation module is required.

d) The offered equipment must be equipped with necessary hardware and software with license for OTDR functionality.

Any disagreement/deviation will be treated as "**Critical Deviation**" individually for each sub-clause.

2.2.3 General Features of the DWDM system

The DWDM System supplied by the Bidder must meet the following criterion:

i) The equipment shall implement centralized switching and synchronous multiplexing at ODUk levels, VC levels and Ethernet synchronous.
ii) The devices are capable of being configured to any type of DWDM systems i.e. OTU, OADM, OLA etc. and associated with Network Management System (NMS).
iii) The equipment must support the WSS and implementation of GMPLS (RFC 3945) and/or ASON (ITU-T G.8080) for restoration requirement in the offered model and sub-rack. The GMPLS/ASON control plan is adopted in Optical Channel (Och) scenarios.
iv) The equipment shall have plan/concrete roadmap of inter-working with the IP/MPLS routers. The inter-working should base on latest ITU-T, IETF, and OIF standards.
v) The equipment must support 100G/200G/400G on line side and support 80/96 channels on line side, the proposed DWDM network shall be based on minimum 100G line per channel with minimum 80 channels available on line side.

vi) The DWDM equipment shall support non-blocking ROADM architecture.

vii) The Client ports and line (Transponder) ports must be on separate cards and shall be connected through backplane.

viii) The equipment should support Centralized Switching with ODUk (k=0/1/2/2e/3/4/flex) levels capacity.

ix) Equipment should support multiple protection architecture based on OCH/OMS or OTS with optical switching module or OTN switch, having protection switching achieved within 50ms.

x) Both Line side and Client-side protection must be possible.

xi) The line card (Transponder) must be able to sync fast enough so that effective switching time from main to protection path does not exceed 50ms. Service-level switching time must not exceed 50ms neither for line side protection switching nor for client-side protection switching.

xii) Wavelength Grid and DWDM system capacity shall be, as defined in ITU-T recommendation G.697.1 Wavelength channel spacing, should be flexible (flexi grid supported).

xiii) The OSC (optical supervisory channel) channel and service channel must be separated and OSC channel shall not be amplified.

xiv) The DWDM system shall have the modularity and scalability of at least 80/96 ch system architecture for Point-to-Point, ring and mesh network application.

xv) The line card (Transponder) must be software tunable type and can be tuned to any of 80/96 channels on Standard and offset ITU-grid within the full C band spectrum.

xvi) The line card (Transponder) must be flexi rate modules capable to support modulation with bandwidth of 100 Gbps or 200 Gbps on line side and the transmission rate should be software configurable.

xvii) The supplier's solution shall support WSS/ROADM architectures for wavelength grooming with reference topology for 50 GHz / 100 GHz operation.

xviii) The DWDM system shall support and provide all type and capacity of WSS (ROADM) to Re-Route any optical Channel from any path to any path among all paths connected to that node (For all possible restoration paths).

xix) DWDM system shall support Remote NMS Reconfiguration, at least 80/96 Och reconfiguration with access to all channels and switching between common port and switched ports.

xx) The DWDM system shall support a modular and flexible architecture, in order to allow scaling, the equipment in accordance to the network requirements.

xxi) Optical equipment should be able to cater the required link Budget (Total loss of cable at each span) along with 3 dB (On top of cable loss) margin for each span.

xxii) It shall be possible to equip the DWDM system progressively, in accordance to the number of wavelengths transmitted, in order to allow real “pay as you grow” configurations.

xxiii) The DWDM system shall be in-service upgradeable from one wavelength up to its maximum wavelength capacity.

xxiv) The proposed DWDM system should be able to ensure hitless in-service insertion of new channels or removal of channels, with ability to automatically adjust/tune.

xxv) The DWDM system shall support Automatic Power Equalization (APE). The system shall be capable of automatically adjusting power per channel to its optimum value, if and when channels are added or removed without the need for manual adjustment.

xxvi) The DWDM system shall support all type of architecture i.e. Optical Terminal Multiplexers (OTM), Reconfigurable Optical Add and Drop

Multiplexers (ROADM), sharing the common modules, in order to minimize the number of spares.

xxvii) The DWDM system shall support Protection and subsequent restoration of traffic using Layer 0 (L0)-ASON/GMPLS/Optical ASON.

xxviii) The DWDM system shall support OTDR functionality and able to measure without impacting traffic while DWDM system is in service.

xxix) DWDM system must accommodate ROADM functionality if required and Tunable Transponder.

xxx) The system shall have a built-in Optical Spectrum Analyzer (OSA) in card(s) and show the performance in the NMS GUI without influencing service during measuring.

a) Supports online monitoring of 10G/40G/100G/200G/400G signal system performance, include multiplexed-wavelength optical power, single-wavelength optical power, OSNR, BER, gain, attenuation, fiber loss, and flatness.

b) Supports in-service performance optimization, supports visualized analysis of optical-layer performance data.

c) Supports comparison with historical performance data, and provides reports.

xxxi) The equipment shall support co-transmission of 100G with 200G/ 400G lambdas in same DWDM network.

xxxii) The service slot for 100G transponder/Muxponders/line board/ tributary board should be universal in the same sub rack.

xxxiii) The 100G line card shall support any mixture of ODU (K=0,1,2,2e,3,4) granulars multiplexing into ODU4.

xxxiv) The 100G Transponder /TDM Muxponders shall support OTN processing according to ITU-T G.872, G.798 and G.709.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.4 Requirements of Online System Performance Monitoring

i) The DWDM equipment system shall have the capability to monitor system performance online without circuit interruption.

ii) The DWDM equipment system shall support monitoring and estimating OSNR, measure optical power of each channel. Operator shall be able to view the related data in NMS.

iii) The DWDM system shall support OTDR functionality. Operator shall be able to view the related data in NMS.

iv) The DWDM system should support real time BER performance and monitoring and raise an alarm when the BER cross configurable margin.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.5 Requirements of the Optical Transmission Unit (OTU)

OTU shall have the following basic functions:

i) Access service: Support 100GbE, 10 Gb (STM-64) and 10GbE.

ii) 100GbE overhead processing shall conform to the IEEE802.3ba standard.

iii) Optical interface of OTU S/R side shall meet one or more optical interface standard defined in ITU-T G.691, ITU-T G.693, ITU-T G.959.1, and IEEE

802.3ba, 10 × 10 MSA technical specifications.

iv) 10xSTM-64 multiply to 100 Gb/s

a) Optical interface for client shall support the transparent transmission of 10 Gb/s. The wavelength from output in the line side shall meet the standard of ITU-T G.697.1.

b) Branch route optical interface shall possess the ability to intercommunicate with the optical interface using the same standard from other manufacturers.

v) 10x10GbE multiply to 100 Gb/s

vi) The proposed system shall comply GFP mapping according to ITU-T G.7041 and the bidder shall describe its support to the following Ethernet encapsulation schemes referencing the offered 10G/100G Transponders/Muxponders as applicable. Moreover, the bidder shall clarify if the mapping of Ethernet to OTN is according to G.709 and if both GFP-F and GFP- T mapping options are available, emphasizing the benefits of the supported encapsulation scheme.

10 GbE into ODU2e in timing transparent manner
10 GbE on VLAN and ODU-Flex on OTN GMP

vii) The bidder shall describe their solution for mapping 10GE LAN PHY/10GE WAN PHY to ODU-2.

viii) The bidder's solution shall support 10 x STM-64 / 10GBE LAN PHY / 10GE WAN PHY signals mapped into ODU4.

ix) The bidder’s solution shall support SDH/ETH/OTN/SAN bidirectional AES 256 service encryption.

x) The bidder's solution shall support STM-64 / 10GE signals mapped into ODU4.

Any disagreement/deviation will be treated as **“Critical Deviation”** individually.

2.2.6 Requirements of Optical Add Drop Multiplexers (OADM)

OADM shall have the following basic functions:

i) Support add/drop of wavelength of 100Gb/s single channel rate;

ii) The operation of drop wavelength shall not affect pass through /straightway wavelengths;

iii) In case of upstream optical fiber broken, it will not affect the normal work of the downstream business;

iv) In case that addition of new channels is required in DWDM node, the addition should not influence/stop service, performance and function in existing channels.

v) Optical amplifiers such as pre amplifier, booster can be used, if necessary.

vi) The optical amplifiers must respond automatically to changes in the number of channels without the need for manual intervention or realignment. Automatic loss compensation/power adjustment technologies should be applied. The system gain should be automatically adjusted in order to compensate the change of system loss caused by fiber aging or other reasons.

vii) The maximum transporting distance (reach of line card/transponder) needs to be sufficient to cover the PGCB’s longest path requirement in PGCB SMF.

viii) Optical amplifier needs to compensate the loss of optical power according to type of use.

ix) The offered ROADM/WSS in the Bid must support minimum 4 cable directions and the system should support WSS of 8 port and higher.

Any disagreement/deviation will be treated as "**Major Deviation**".

2.2.7 Requirements of Safety

DWDM System shall have the following safety issues:

i) Laser and optical fiber amplifier have the obvious safety signs to ensure personal safety. The system is certified as a Class 1M laser product with hazard level 1M according to the IEC 60825-1 and IEC 60825-2 or any equivalent standards.

ii) When the fiber is disconnected, according to the recommendations of the G.664 to support the APR function, and has automatic / manual restart process.

2.2.8 Requirements of Automatic gain equalization and power control

DWDM System shall have the following requirements for automatic gain control equalization and power control:

i) Must have automatic gain equalization and automatic power control function.

ii) The process of Channel power dynamic control does not affect the other channel which is adjusted and the work of online business service.

iii) N x 100 Gb/s DWDM system can support the function of line power dynamic adjustment which does not influence the regular working service.

iv) Increase/decrease the channel without interrupting the business service.

v) Automatic equalization function can realize the dynamic adjustment.

vi) The equipment shall support in-service gain/tilt adjustment without interruption of service.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.9 Requirements of Protection Scheme

DWDM System shall have the following requirements for protection scheme-

i) The system must support Optical Line Active/Protection switching using Optical Protection switch (OPS) or OTN switch.

ii) In any case, the switch time of Optical Line Active/Protection switching should be no more than 50ms excluding the detection time.

iii) It should be easily managed by same NMS system as DWDM equipment and another optical card (amplifier card, MUX/DEMUX card etc.).

iv) Protection switch of all traffic shall be triggered on optical power monitoring and there shall be provision to set the LOS thresholds.

v) Automatic switching shall be triggered by line faults (LOS, LOF etc.), OCh layer faults.

vi) The switching priority of Optical Line Active/Protection switching should support functions like Clear Switching, Forced Switching, Automatic Switching.

vii) Revertive operation must be provided.

viii) Non-revertive operation must be provided.

ix) Provision able "generic hold-off function" must be provided.

x) Lockout of protection and forced switch commands shall be supported.

xi) The system should have the fault notification function in order to notify the external terminal equipment connecting to downstream system of fault occurred on the Network

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.10 Requirements of Restoration Scheme

DWDM System shall have the following requirements for Restoration scheme-

i) For Restoration, all OADM sites must be able to Re-Route Optical Channels. Re-routing will be possible from any path to any path among all paths connected to that node.

ii) Restoration path from source node to destination node must be created automatically.

iii) The system must be able to create consecutive restoration paths one after another at multiple fiber cut scenario, as long as a single path is available between the two nodes.

iv) The solution shall support and provide all type and capacity of WSS (ROADM) to Re-Route any optical Channel from any path to any path between all paths connected to that node.

v) The equipment must support the WSS and implementation of GMPLS (RFC 3945) and/or ASON (ITU-T G.8080) for restoration requirement in the offered model and sub-rack. The GMPLS/ASON control plan is adopted in Och scenarios.

vi) The control plane should support automatic discovery of the network topology and network resources.

vii) ASON/GMPLS should support the calculation of the source node route.

viii) Restoration will be possible without requirement of any regeneration of line signal in between Source and destination node.

ix) The transmission system shall give alarm or indication to router/switch to stop transmission/packet forwarding on 10GbE ports of transmission Ethernet card, if there is link down between transmission media due to fibre cut or some fault.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.11 Requirements of OTDR Scheme

DWDM System shall have the following requirements for OTDR function which must be compiled-

i) Operating Wavelength: Any or multiple wavelength between 1500 nm to 1650 nm.

ii) Resolution: ±3 meter

iii) Should measure at least 25 dB per direction.

iv) Measure from both sides into same fiber.

v) OTDR measurements should be possible while DWDM system is in service.

vi) OTDR measurements should be done without impacting traffic while DWDM system is in service.

vii) No extra optical fibre core will be required or allocated for OTDR function.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

2.2.12 Requirements of Availability

The system availability shall be higher than 0.99999.

Any disagreement/deviation will be treated as **"Major Deviation"**.

2.2.13 Requirements of HW Resiliency

DWDM System shall have the following requirements for HW Resiliency

i) The solution will be of modular chassis architectures.

ii) The solution must support insertion, replacement and removal of modules whilst the equipment is powered up without affecting traffic and / or damaging any module.

iii) Each shelf shall have individual shelf control card.

iv) The solution shall provide indications on each individual module to indicate a failure of the module.

v) The equipment shall also have an alarm display showing at least major and minor summary alarms.

Any disagreement/deviation will be treated as **"Major Deviation"**.

2.2.14 Requirements of SW Resiliency

DWDM System shall have the following requirements for SW Resiliency.

i) The supplier shall indicate if control and forwarding parts are separated (autonomous) and if a control failure does affect (or not) the forwarding part.

ii) The supplier shall confirm that SW upgrade and SW patches can be performed without any service interruption and that its solution supports the upgrade of all operating software without any traffic interruption.

iii) Regarding in-service configuration backup and restore features, the supplier shall confirm that its solution has the capability to batch download software and firmware and switch in bulk.

iv) The supplier shall confirm that their solution is capable of autonomous operation, without assistance from the Management System.

Any disagreement/deviation will be treated as **"Major Deviation**".

2.2.15 Requirements of Synchronization

DWDM System shall have the following requirements for Synchronization

i) The system must support clock recovery and stamping based on NTP.

ii) The system shall support transparent transport of IEEE 1588V2.

Any disagreement/deviation will be treated as **"Major Deviation**".

2.2.16 Requirements of Environmental Aspects

The DWDM equipment shall satisfy the following environmental conditions

i) Ambient temperature: 0°C to 45°C for the DWDM.
ii) Relative humidity: Up to 85% at non-condensing for the DWDM.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

2.2.17 Requirements of Optical supervisory channel (OSC)

DWDM System shall have the following requirements for optical supervisory channel.

i) Must have separate optical supervisory channel.
ii) The wavelength of optical supervisory channel is 1510nm ± 10nm.
iii) The BER performance of optical supervisory channel should be in the range of 1.0Exp (-3) to 1.0Exp (-12).
iv) The failure and replacement of filters units cannot affect the DCN communication via OSC.
v) The failure of an OSC unit must be non-traffic affecting.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

2.2.18 Requirements of system reliability

DWDM System shall have the following requirements for system reliability.

i) At least 80/96 OCh Mux/Demux shall be supported.
ii) The Optical (photonic) part i.e. WSS, Amplifier, OSC, OPS etc. must be equipped in optical sub-racks. Design of mechanical device is a rack-based system and sub rack/ shelf according to standards such as ETSI ETS 300 119 or equivalent.
iii) Line cards (Transponder), Client cards, OTN Switch (If used) can be equipped in separate sub racks from the optical sub-racks.
iv) Line port and client port must be on separate cards.
v) All sub-Rack must have power redundancy.
vi) All Sub-Rack must have controller redundancy.
vii) OTN switch (If used) must have redundancy.
viii) All the ports in any type of card and or device be active or passive must be useable instantly when required without any further requirements of related software/license.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

2.2.19 Requirements of Power

For the DWDM equipment, the input voltage will be -48 VDC (-60 ~ -42).

Any disagreement/deviation will be treated as **"Major Deviation**".

2.2.20 Requirements of Operating conditions

Following Operating conditions to be fulfilled.

i) The bidder shall describe the number of equipment in each rack as well as the expansion possibilities of the different equipment in the same or in other racks
ii) The slots for DWDM board such as transponder, line board, tributary board, OADM, amplifier, coupler, protection board and etc. should universal in the same sub rack.
iii) The bidder shall indicate the average and maximum power consumption of their solution at normal working conditions.
iv) The bidder shall list the EMC standards met by their solution
v) The bidder shall describe the ventilation elements like fans, coolers, filters, fan alarms of their solution.
vi) The bidder shall state their compliance with regards to:
    a) IEC 60825 (Optical Safety)
    b) ETSI 300-019-1-3 (Climatic)
    c) ETSI 300-019-1-2 (Transport)
    d) ETSI 300-019-1-1 (Storage)
    e) IEC 60950 Safety of Information Technology equipment
    f) EN 300-386-2000 Electromagnetic compatibility and Radio spectrum Matters (ERM), telecommunication network equipment, EMC requirements
    g) ETS 300-753 Acoustic noise emitted by telecommunications equipment

2.3 Network Design

In order to achieve the intended goal of the purchaser, Bidder during designing and configuring the equipment at each site shall follow the following fundamental rules;

2.3.1 General Guidelines for Basic Network Design Principle

i) The bidder shall quote for the planning and design tools in Schedule B7, Volume 3, which will be provided to PGCB for future planning purpose (if Required). The planning and design tool/s should include the followings: optical network design and simulation, Network structure diagram, Traffic allocation diagram, Wavelength allocation diagram, Rack configuration allocation diagram, Analysis reports, per node power consumption, Mechanical installation report, etc. Fore more clarification, please refer to Schedule A, Volume 3.

ii) Fixed Optical Add Drop Multiplexer (FOADM) is not allowed in the network.

iii) For line side, Optical Channel (Och) of only 100G lamda will be used.

iv) Line signal Protection and Restoration facility must be implemented.

v) Regeneration of line signal in between Source and destination node (Anywhere in between the Main, Protection and restoration paths) is not allowed.

vi) Use of external Dispersion Compensation module is not allowed.

vii) Line and Client ports must be on separate cards.

viii) Inbuilt OTDR functionality must be provided for all fiber connectivity between all nodes.

Any disagreement/deviation will be treated as "**Critical Deviation**"

2.3.2 Network Topology and Link wise Loss Table for Design Principle

The network topology with all nodes and fiber connectivity with approximate distance and total dB loss (maximum value) between the nodes are given in Annexure 1 and Annexure

3 of this Volume 2.

2.3.3 Minimum Optical link Margin between Hops

For the planning and design of the network and choice of different line cards and amplifiers, bidder has to consider minimum margin of 3 dB for each adjacent hop on top of the db loss mentioned in Annexure 2 of this Volume 2.

Any disagreement/deviation will be treated as "**Critical Deviation**".

2.3.4 Line and Client-Side Traffic Information

The requirements of different Line and client interfaces of the DWDM equipment at different sites are given in Annexure 2 and Annexure 4 of this Volume 2.

2.3.4 Service (Traffic) Scheme Design

i) DWDM network service demands are defined at 10G/10GbE/100GE client service rate level and mentioned in Annexure 2 (Requirements of different Line and client interfaces of different sites) and Annexure 4 of Volume 2. Bidder must equip and quote necessary SFP/XFP/CFP/optical interface module according to the service requirement.

ii) Optical module of client side should be minimum 10 KM of length.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

2.3.5 Network Protection and restoration

a) To cope with simultaneous multiple failures both protection and restoration functionalities shall be provided.

b) Line side protection to handle the 1st break (Optical Fiber/equipment failure) must be done in an automatic manner within the maximum 50 ms delay excluding failure detection time.

c) For the 2nd break and/or consecutive break, restoration is required in an automated manner as long as a single routing path is available.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

SECTION 3

NETWORK MANAGEMENT SYSTEM (NMS)

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SECTION 3

NETWORK MANAGEMENT SYSTEM (NMS)

3.1 SCOPE

These clauses describe the General Technical Requirements for The Network Management System (NMS) solution for the monitoring and management of the devices and network. The NMS shall be fully centralized for management of all network elements (NE), offering the possibility to perform network management tasks from single site or several sites. The NMS shall be of Browser/Server (B/S) architecture or Server and clients-based architecture.

The NMS system shall be provided with user-friendly interfaces based on Unix and/or Linux and/or windows operating system. The NMS shall be able to provide an on-screen view of the managed network. It shall be possible to access any managed NE from the whole network in the managed domain. The NMS shall be able to depict the failure state of each link and node in the displayed network.

Further, it shall be possible from the NMS system to get the details of status of an individual managed NE, such as equipment presence, settings, alarm status etc. It shall be possible to add/delete/configure/modify a NE by point & click feature.

Installation, testing & commissioning of NMS shall be done with the expert Network engineer(s) of the corresponding equipment manufacturer(s).

3.2 NMS Management Facility

The following Management facilities must be provided:

i) Fault Management
ii) Configuration Management
iii) Inventory Management
iv) Security Management
v) Alarm & Event Management
vi) Performance Management
vii) Software upload/download capability
viii) Backup and Restoration Management of all NE

Any disagreement/deviation will be treated as "**Critical Deviation**".

3.3 Visualization of Network domain

The following requirement for Network domain visualization must be provided:

i) NMS shall provide end-to-end visualization of wavelength paths
ii) NMS shall provide end-to-end display of optical power measurements
iii) NMS shall provide for details for end-to-end wavelength channel provisioning and automated wavelength channel restoration.
iv) NMS shall provide visualization of OTDR report of fiber spans.
v) Supports intuitive visualization of the network-wide latency.

Any disagreement/deviation will be treated as **"Critical Deviation"** individually for each sub- clause.

3.4 Features of Network Management System

The following requirement for NMS must be provided:

i) The NMS shall run on Unix/Linux/Windows platform.
ii) NMS shall be connected to the proposed node equipment via IP interface.
iii) NMS should provide web-based client interface which enables anywhere management.
iv) NMS must support E2E service configuration, monitoring and performance checking.
v) NMS must support user-friendly GUI and easy point & click operations.
vi) NMS should support quicker end-to-end provisioning of multi-service, including WDM circuit, SDH circuit, Ethernet circuit, and wavelength transport.
vii) NMS should provide Fault, Configuration, Performance & security features in their respective Window.
viii) NMS must support Ethernet OAM standards such as Y.1731,
ix) The NMS shall provide management functionalities and web-based management.
x) The NMS shall support remote downloading of all types of software and firmware required by WDM equipment.
xi) The system shall support up-gradation of the software version preloaded in the system without loss of traffic or configuration.
xii) System shall allow revert back to the previous version of the software.
xiii) Download failure on the NE shall not affect other applications running on NMS.
xiv) The NMS should have the capability of auto discovery of new NE.
xv) NMS shall provide the inventory details of all systems in the network up to card and SFP/XFP/CFP level with simple operation.
xvi) NMS shall have report generation capacity such as Number of configured WDM circuits, SDH circuits, Ethernet paths, used and unused capacity of each Network Element etc.
xvii) NMS shall provide Comprehensive network map of all the managed elements with a sophisticated alarm and traffic status display, real time alarm and traffic monitoring and giving a full access to all NE technical management features through a user-friendly interface.
xviii) NMS shall support SNMP, TMF CORBA & REST NBIs
xix) NMS shall support FCAPS via REST NBI
xx) NMS shall have capability for interworking with 3rd. Party SDN/Orchestration Solutions.
xxi) NMS shall have capability for integration of 3rd. Party NEs via SBI.
xxii) NMS shall support Warm/Hot Standby Server Redundancy Solution (Max. 10 Sec. for Switching over between Main & Standby Servers).
xxiii) In Warm/Hot Standby concept, NMS shall support automatic switch-over between Main Server and Standby Server (without user-intervention).
xxiv) In Warm/Hot Standby concept, after switch-over to Standby server, all clients must be automatically switched-over to Standby Server (without user-intervention).

Any disagreement/deviation will be treated as **"Major Deviation"**.

3.5 General Requirements of NMS Design

The NMS consisting 1 (One) server and 1 (One) client hardware along with any switch/router required and all necessary software with license will be quoted and installed/commissioned at Aftabnagar (PGCB HQ) site. Bidder will also quote and supply 1 (One) Laptop (Craft Terminal) with appropriate software with license to connect DWDM equipment directly so that configuration, monitoring can be done from the Laptop.

i) Minimum number of NE handling by NMS shall be 60 (Sixty) Nodes for DWDM Equipment.
ii) Minimum number of WS (Client) can be connected to NMS shall be 20 (Twenty).
iii) Minimum 5 (Five) users can login a server and work simultaneously.
iv) Minimum 20 (Twenty) Performance measurement can be initiated in the system and data can be recorded simultaneously.

Any disagreement/deviation will be treated as **"Critical Deviation".**

3.5.1 General Requirements of NMS Hardware

The following hardware requirement for NMS must be provided:

i) The NMS shall consist of Server and clients-based architecture.

ii) There will be provision to use Laptop/Notebook as Local Craft terminal (LCT) with appropriate software with license to connect DWDM equipment directly so that configuration, monitoring can be done from the Laptop. The LCT shall be able to connect all network elements on the same network (autonomous system) from locally connected device.

iii) Required HW resource for Server, Client workstations, Local Craft Terminal i.e.

CPU (type and number of cores, speed)
RAM (Capacity)
Disk (Capacity + required partitioning)
Number of network interfaces
Platform power consumption,
power protection
Other HW requirements

should be chosen for each management entity according to the total size of the network and no. of node / NE to be managed and monitored by the NMS.

Any disagreement/deviation will be treated as **"Major Deviation"**.

3.5.2 Technical Specifications of NMS Hardware

Bidder will quote NMS hardware with minimum specification. Bidder may suggest different manufacturer's equipment in that case, PGCB will be free to choose as per their wish among the suggested equipment(s)

NMS Server Specifications:

Processor : 2*Xeon E5-2680 v4 2.4GHz;
Memory : 64 GB RAM
Hard Disk : As necessary (Minimum 4TB, SSD Preferable)
Other drives: As necessary

Equivalent or better to meet the requirement

Client PC Specifications:

CPU : Intel I7 (8th Generation or equivalent);
Memory : 16 GB DDR4 RAM;
Hard Disk : As necessary
Monitor : 65-inch LED TV/Monitor
(HP/ Sony/ Samsung/ Sharp/ or Equivalent).
Assembled in Thailand/ Malaysia/ Taiwan/ Korea/ Japan/ USA/ EU Countries)
Other drives: As necessary

Equivalent or better to meet the requirement

Laptop (LCT) Specification:

CPU : Intel I7 (8th Generation or equivalent);
Memory : 16 GB DDR4 RAM;
Hard Disk : As necessary
Other drives: As necessary
Monitor : 15.6" FHD LED monitor or higher
Other Facility: Wi-Fi, Bluetooth, and etc.

3.5.3 Requirement of NMS Software

The NMS software shall be based on Unix and/or Linux and/or Windows based operating system. The NMS shall be a multi–task and multi-user system. The offered software architecture shall be open and configurable to enable future extensions. Software license shall be quoted for life time (at least 8 Years). During this tenure, if there is any upgradation of the manufacturer occurs, the bidder/ manufacturer will be liable to provide the upgraded software license **"free of charge"** to PGCB.

PGCB will be free to choose among Unix and/or Linux and/or Windows based operating system proposed by the bidder.

Any disagreement/deviation will be treated as **"Critical Deviation"**.

3.6 General Functionalities of the NMS

3.6.1 Fault and Alarm Management

All fault and alarm events shall be reported. Adequate arrangement for display and logging shall be provided if there is any event received at the NMS. All alarms received at the NMS shall cause a change of color/add object on the appropriate object on screen. There shall be visible indication on screen that there is an alarm somewhere in the system. In addition to the displays, alarm details may be displayed in tabular format.

i) NMS should provide real time surveillance of network faults from the various alarm captured from the network elements.
ii) Severity of alarms will be further specified as warning, minor, major and critical.
iii) Alarms in any Node/NE shall be shown by the NMS.
iv) Fiber Link/Path (Fiber Cut / High Loss) alarm shall be shown by the NMS.
v) The reported alarm shall have date and time stamped.
vi) Alarms shall be displayed on NMS screen in different color/object representing the severity (critical, major and minor) and the state of the alarm. The operator shall be able to acknowledge and investigate the cause of the alarm.
vii) Single alarm window for all NEs displaying network active alarms, cleared alarms, severity of alarms.
viii) Alarm list, threshold and severity should be customized.
ix) System shall be capable to log performance parameters on 15 min/24 hours basis and made available whenever required through NMS beside current register counters, NMS shall be capable of storing history register counters for the last one months and if required can be exported to the external hard disk.
x) There should be facility to send SMS/Mail for various alarms. This should be configurable on basis of alarms and SMS/Mail list to be configurable.

Any disagreement/deviation will be treated as **"Major Deviation"**.

3.6.2 Configure Management

The NMS shall meet the following requirements:

i) E2E service provisioning
ii) Port settings.
iii) Loopbacks.
iv) All configurable parameters for the equipment shall be configured using the NMS.
v) Should be possible to create, configure, provision and manage the traffic based on bandwidth and QoS requirements.

Any disagreement/deviation will be treated as **"Major Deviation"**.

3.6.3 Performance Management

Each NMS's performance shall meet the following requirements:

i) System has to be able to collect all standard quality parameters/indicators for WDM/SDH based part as well as for packed switch part in accordance with related standards. Data shall be available for online and offline data analyzes. System shall provide tools to analyze and report quality parameters/indicators from network on network level (for each network service). It means that system shall provide quality report not only on node/element level but also on network service level.
ii) For Performance reports, all performance parameters to be monitored on 15 min, hour, day, month and weekly basis.
iii) The receiving level monitoring to be provided on real time basis - both in table as well as graphical view with time stamp.
iv) The system should be able to monitor service quality parameters regarding availability on real time basis.

v) It should be possible to monitor packet drops in case of Ethernet interface.
vi) Comprehensive Ethernet performance counters & utilization reports generation must be supported by NMS.
vii) Support to MIB access must be available for integration / real time utilization monitoring by third party systems i.e. MRTG etc.
viii) Facilities should be available to backup stored log data and other data.

Any disagreement/deviation will be treated as **"Major Deviation"**.

3.6.4 Security Management

This functionality shall provide necessary security to the data as well as access to the network.

Any disagreement/deviation will be treated as "**Major Deviation**".

3.6.4.1 Access Security

i) Facilities shall be provided to ensure that only authorized users are allowed to access all or a certain part of the system. These include comprehensive log-in operator identities and password facilities. Low level protection for read only access to faults and performance information, Medium level protection for access to configuration status and features and High-level protection for control of access to aforesaid clauses and to change in the configuration and control parameters. All Log in and Log out attempts shall be logged in the security Log File of the NMS system.

ii) Access to NMS must be governed by user-password. It should be possible by system admin to define users with 'what he can do' and which NEs he has access to.

iii) It should be possible to require complex passwords (alphanumeric with special characters), set password expiration time for all user and automatic lockout of user account after certain number of failed login attempts.

iv) System shall support following authentication and authorization mechanisms for security management on management system level as well as on element level:

RADIUS or TACACS+ or Microsoft authentication protocol.

Any disagreement/deviation will be treated as "**Major Deviation**".

3.6.4.2 Data Security

Adequate arrangement to protect data and to recover data lost due to stoppage or failure of the EMS hardware or communication system is to be provided. The NMS shall be able to back up and restore the data base to and from external storage media or internal storage media.

Any disagreement/deviation will be treated as "**Major Deviation**".

3.6.5 Inventory Management

System shall support:

i) Scheduled automatic inventory data collecting and storing.
ii) Listing and filtering inventory data.
iii) Exporting inventory data.

Any disagreement/deviation will be treated as "**Major Deviation**".

3.6.5.1 HW inventory

System shall support collecting and storing installed HW inventory data (e.g. hardware configuration, serial numbers, card positions, etc.).

Any disagreement/deviation will be treated as "**Major Deviation**".

3.6.5.2 Service inventory

System shall support collecting and storing information about configured network services in the network.

Any disagreement/deviation will be treated as "**Major Deviation**".

SECTION 4

DC POWER SYSTEM

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SECTION 4

DC POWER SYSTEM

4.1 General

DC power plant (-48 Volt) equipment are required for the Optical Fiber Platform at different sites. The DC power plant will consist of the Rectifier, the Battery and the associated power distribution panels. The Contractor shall make necessary DC wiring from the assigned DC PDB to the DWDM/OLA equipment. Inverter/UPS is used for feeding uninterruptable power to the NMS of the optical transmission system. Detail specifications of the Rectifier, Battery and Inverter are given below:

(a) Basis of Design

The equipment shall comply with IEC 60590 and IEC 478 or any equivalent standard.

The charger shall be of either the thyristor-controlled type or of the SMPS type. The battery shall be sealed Lead-acid battery (maintenance free)- as detailed in a separate section of this Specification.

The design and selection of equipment and components shall be based on achieving a minimum lifetime of 20 years, when operating under the specified service conditions.

(b) Operating Principle

The output of the charger shall, during normal operation, continuously supply the power requirements of the load whilst simultaneously maintaining the battery charge in the float charge mode. In the event of an interruption in the a.c. mains supply to the charger, the battery shall supply the load requirements for not less than the specified standby time - whilst maintaining the output voltage within permissible limits.

Upon restoration of the a.c. mains supply, the rectifier shall automatically resume supply of the load requirements whilst simultaneously recharging the battery at the float voltage.

4.2 Rectifier and Battery Charger Unit

Necessary rectifier (modular type) will be used as DC power source to run the system and to charge the back-up batteries.

i) The charging current for the back-up batteries considered at 10 hrs charging rate.
ii) The minimum capacity requirement of the rectifier set will be as follows.

For ROADM Site (Patuakhali, Barisal): 02 (Two) Sets

Required DC output capacity each site (C) A	: 450 A
DC output Capacity of each offered rectifier module (O)	: 50/75/100/150 A
Number of Rectifier modules to be supplied at each site	: N+1
Where, N= Present equipped DC output capacity (C) ÷ DC output Capacity of each module (O) (If N becomes a fraction then the next integer will be considered)	

For Other ROADM Site: 09 (Nine) Sets

Required DC output capacity each site (C) A	: 300 A
DC output Capacity of each offered rectifier module (O)	: 50/75/100 A
Number of Rectifier modules to be supplied at each site	: N+1
Where, N= Present equipped DC output capacity (C) ÷ DC output Capacity of each module (O) (If N becomes a fraction then the next integer will be considered)	

For OLA and NMS Site: 11 (Eleven) Sets

Required DC output capacity each site (C) A	: 150 A
DC output Capacity of each offered rectifier module (O)	: 50/75 A
Number of Rectifier modules to be supplied at each site	: N+1
Where, N= Present equipped DC output capacity (C) ÷ DC output Capacity of each module (O) (If N becomes a fraction then the next integer will be considered)	

iii) The bidder shall provide the details of rectifier dimensioning.

iv) The size of the rectifier rack shall be such that there is enough gap between floor and the rectifier modules. Failure to give detail breakdown shall be treated as non-compliance and in such case PGCB shall draw its own conclusion.

v) The Rectifiers shall be electronic switch-mode type with automatic redundancy control and charging control functions.

vi) The control panel shall provide visual and audible alarm facilities and required provision for alarm loops for connection to the remote monitoring system. The display in the control panel shall have the facility to show all types of alarm and other necessary data such as input voltage and current of each phase, output voltage and current, battery current etc.

vii) There shall be provision for over voltage, under voltage, over current and over temperature protection.

viii) There shall be Low voltage cut-off mechanism to save the battery from deep discharge and the rectifier shall be equipped with necessary surge protector.

ix) The rectifier shall be provided with circuit-breakers (both in AC & DC side) of adequate capacity and shall allow full isolation from the source and the load.

x) The Rectifier Rack (or Frame) shall be provided with AC and DC power distribution panel with necessary circuit-breakers (both in AC & DC side) of adequate capacity and shall allow full isolation from the source and the load.

xi) If all of the rectifier modules are taken-out of service, provisions shall be there for automatic diversion of the load to the battery.

xii) The rectifier rack shall contain one or more DC distribution panel consisting of circuit-breakers of 10A, 16A, 32A, 63 A and 125A capacity (at least two numbers of each capacity).

xiii) There shall be provision in the rectifier for connecting at least two sets of Battery. There shall be breaker of adequate capacity for each set of Battery and the breaker should be easily to disconnect.

Any disagreement/deviation will be treated as **"Major Deviation**".

4.2.1 Technical Specifications of the Rectifier Unit

The rectifier to be supplied by the bidder shall fulfill the following criterion-

a)	A/C input voltage	:	160 V ~ 260V
b)	Frequency	:	45 Hz ~ 55 Hz
c)	Efficiency	:	90% or more
d)	Protection	:	Input Over Voltage, Input Under voltage, Output Over voltage, Over load, short circuit, Over Temperature, Surge and transient
e)	Output voltage	:	-48 Volt nominal (43 ~ 54 or better)
f)	Output current/module	:	Bidder shall mention
g)	Static voltage regulation	:	± 0.5%
h)	Ripple and Noise	:	<300 mV p-p, <2 mV rms
i)	Cooling	:	Forced cooling with internal fan
j)	Operating Temperature	:	0°C to 45°C
k)	Operating Humidity	:	Maximum 80% non-condensing

Any disagreement/deviation will be treated as **"Major Deviation**" for each sub-clause.

4.2.2 Features of the Battery Charging Unit

(a) General

i) The charger shall operate according to the constant voltage current limiting principle and shall incorporate a soft start feature to gradually accept load on initial energizing.

ii) The charger shall restart automatically upon restoration of the a.c. mains supply following a mains supply interruption, and recharge the battery at the float voltage.

iii) Internal cooling shall be by natural ventilation. Forced cooling is not acceptable.

iv) The charger shall be suitable for operation in parallel with one or more chargers, and shall include a current sharing facility.

v) The charger shall be of sufficient output capacity for the application, parallel operation of chargers (where required) is for the purpose of redundancy and not to satisfy the output current requirements.

vi) The charger must be equipped with required no. of circuit breakers (with redundancy) to charge the battery unit(s).

(b) Charger Output

i) The output characteristic shall provide an output voltage regulation of ±1%, over the specified a.c. mains voltage and frequency range and for load changes 0-100%.

ii) The output voltage regulator shall be adjustable within limits approved by the Engineer and shall be so designed that special tools are not required for such adjustment. Compensation for battery temperature shall be provided.

iii) The charger shall have protection against overloads or short circuits and shall limit the output current. Recovery to a constant voltage characteristic shall occur automatically at the end of the overcurrent/short circuit.

(c) Boost Charging

i) Manual boost charging shall be provided. A boost timer shall be included to prevent overcharging.

ii) Operation of boost charging shall disconnect the charger and battery from the load. It shall not be possible for both chargers to be selected to boost charging at the same time, or for the load to become disconnected from both batteries and chargers simultaneously.

iii) If the a.c. mains supply fails during boost conditions the two batteries shall be automatically connected in parallel by “no volt” contactors to the load.

iv) It shall not be possible to connect a “boosted” battery to the load until its terminal voltage has fallen below the load equipment upper voltage limit.

(d) Noise and Interference

i) To avoid unacceptable levels of electrical noise in the load equipment smoothing of the d.c. output is required. This shall achieve a sophomoric noise level at the output, for loads between 0 and 100%, not exceeding the equivalent of 2 mV at a frequency of 800 Hz after weighting as specified by ITU-T (CCITT).

ii) The relative harmonic content of the input current shall comply with the European Directive for EMC, the EN 60555-2 or another equivalent standard. In the case of SMPS chargers active power factor correction (i.e. boost for step up converter) shall be provided to control the power factor.

iii) The production of radio frequency interference voltages shall not exceed the values of suppression grade “N”, as defined in EN 55014/55015 or another equivalent standard - for thyristor-controlled type chargers, and suppression grade “B” as defined in EN 55022 or another equivalent standard for SMPS type chargers.

iv) The performance of the DC power supply equipment unit shall not be affected, or in any way degraded, by the use of the following when the severity of the electromagnetic radiation environment corresponds to Class 3, in accordance with IEC 801-3 or another equivalent standard:

- private mobile radio operating in designated or
- planned radio frequency bands
- current cellular radio equipment
- future cellular equipment
- mobile data equipment.

It is the Contractor’s responsibility to determine the radio frequency bands applicable in the locality.

(e) Efficiency/Rating

i) The charger efficiency shall not be less than 80%.

ii) All chargers supplied shall preferably have the same rating, or be in fixed multiples, to limit the number of different charger ratings.

(f) Instruments, Controls and Alarms

The charger shall be equipped with the following features-

i) a.c. mains input circuit breaker
ii) d.c. output circuit breaker
iii) charger output current meter
iv) charger output voltage meter
v) alarms for charge fail, d.c. volts high etc.

Each alarm shall be provided with local annunciation and two sets of potential free contacts, for connection to external alarm monitoring systems.

4.3 Battery

Necessary battery sets are required to provide back-up DC power source to run the system during AC mains failure.

(a) Type

i) Lead acid battery cells shall be designed in accordance with latest IEEE/IEC/ANSI standards.
ii) Cell containers shall be non-flame propagating and mechanically shock resistant.
iii) Cells shall be permanently marked with the following information:

- manufacturer's reference number and code
- year and month of manufacture
- voltage and nominal capacity at the 10-hour rate
- cell number.

(b) Mounting

i) The batteries shall be mounted on metal stands, or racks, in a manner such that all the plates of each cell are visible for inspection, test and maintenance purposes. Stands or racks shall have a maximum of two tiers. In all cases adequate space must be left between the tiers for maintenance purposes and to permit the topping up of electrolyte. Stands or racks shall have a protective finish of not less than two coats of electrolyte resisting enamel or gloss paint. Alternatively, an epoxy resin sintered finish may be used.

ii) At locations where the battery is not housed in a separate battery room the battery stand/rack shall be fitted with cladding. The cladding shall permit the free flow of air to the battery, and shall be removable for maintenance purposes.

iii) Cell containers shall be accurately set up in alignment on the stand or rack with lead and/or rubber discs under the feet moulded on each container. Cell lids shall be so positioned that at least one topping up aperture is on the access gangway side of the cell and not obstructed by any inter-cell connecting arrangements.

(c) Battery Main Circuit Breaker

Necessary circuit breakers are required to provide maintain proper operation which must be designed in accordance with latest IEEE/IEC/ANSI standards.

(d) Connections

i) The positive pole of each battery shall be connected to station earth via a single bolted link at the distribution cubicle. Low resistance intercell connectors shall be used. Connections between tiers of cells and between end cells and fuses shall be made with insulated copper rod which shall be of equivalent cross-section to the distribution busbars.

ii) Connections from the battery fuses to the chargers and distribution cubicles shall be made with insulated cable of equivalent cross-section to the distribution busbars. The positive and negative terminals of each cell shall be clearly indicated. The positive and negative terminals of the complete battery shall be indicated by red and black marking respectively.

(e) Technical Requirements for Battery

i) Minimum Capacity of each set of Battery set at ROADM (Barisal, Patuakhali) site: 450 AH.

ii) Minimum Capacity of each set of Battery set at other ROADM site: 300 AH

iii) Minimum Capacity of each set of Battery set at each OLA and NMS site: 150 AH

iv) No. of Battery sets required at each site : 1 nos

v) Back up Required: 10 Hrs.

vi) The Batteries shall be of -48 Volts, 2 Volt each unit.

vii) The Batteries shall be Lead-Acid sealed and maintenance free (VRLA) Gel type.

viii) The minimum guaranteed life-cycle of the batteries must be at least 5 (Five) years or at least 800 cycles of discharge at 80% discharge depth.

ix) Battery sets shall be connected to the rectifier/charger set through circuit breakers of adequate capacity which will allow complete disconnection of both of the battery sets during any required O&M function.

x) In order to protect the exchange equipment as well as the battery in case of dropping of the DC voltage below a certain level, the rectifier connection to the battery sets must be provided with a device for disconnecting the battery sets as soon as such levels arrive.

xi) All of the exposed parts of the terminals in each cell of the battery-sets will be provided with adequate oxidation-proof covers.

xii) The charging-current at 10hrs charging rate for the battery sets, as supplied shall be carried- over to calculation for rectifier requirement.

xiii) The proposed battery shall be capable of operating at non-air-conditioned environment i.e. 0°C to 40°C room temperature and at maximum of 90% humidity (non-condensing).

xiv) The battery charger unit must be equipped with at least 2 nos of 125A circuit breaker.

Any disagreement/deviation will be treated as "**Major Deviation**" for each sub-clause.

4.4 Inverter

Inverter acts as 220V AC power source to run the NMS or other AC power driven equipment at a site. The specification for requirement of the inverter shall be as follows:

a) Input specifications

Operation voltage range: -43 up to -55 VDC
Maximum input current: < 130 A @ -48VDC

b) Output specifications

Nominal output voltage: 220V, adjustable 210~240VAC
Output voltage frequency: 50Hz
Output Power: ≥ 3 KW

c) Technical Particulars:

i) Contractor must provide details of inverter dimensioning.
ii) The inverter shall meet the general requirements of telecommunications power supply standards in terms of noise, voltage programmability, as well as overvoltage, overload and short-circuit protection.
iii) The inverter shall be configured for parallel operation (N+1 load sharing Mode), hot swap and hot plug in.
iv) The control panel shall provide visual alarm.
v) The inverter shall be provided with circuit-breakers of adequate capacity and shall allow full isolation from the source and the load.
vi) The nominal input voltage for the inverter shall be -48VDC.
vii) Nominal operating Temperature and humidity shall be 0°C ~ 45°C and maximum 90% (non-condensing) respectively.

Any deviation of clause 4.4 shall be considered as "**Major Deviation".**

SECTION 5

Civil and Electro-Mechanical Works

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SECTION 5

Civil and Electro-Mechanical Works

5.1 Grounding of the Equipment

An earthing system generally in accordance with the requirements of IEEE 80 and BS 7430 shall be designed under this Contract. Installation and the supply of all materials and equipment shall also be included. The earthing system shall include earth electrodes to provide the connection to the general body of the earth and all conductors and connections to all electrical equipment and metallic structures on the site. The earth electrodes shall limit the potential rise under fault conditions and buried conductors shall be provided to limit potential differences on the site and adjacent to the site to ensure safety to people and animals.

Station grounding works are to be performed by the bidders at all sites. Successful bidder has to install grounding system by placing GI pipes (electrodes) under the ground through boring as per the diagram given in Figure 5.1 below. Two electrodes have to be placed inside the grounding at a distance mentioned in the figure through boring into the ground. Length of each electrode is 50 feet of which upper 40 feet is GI pipe and the lower 10 feet is filter made of brass. The upper part of the electrodes will be interconnected at a depth of 2.50 feet from the surface using GI pipe of same size as the electrodes. The upper part of the GI pipe electrode nearer to the building has to be inserted into the building as shown in Figure 5.1 and then a small piece of GI plate (GI head) has to be fixed on the edge of the GI pipe through welding. A grounding bar has to be installed on the wall which will be separated from the wall by insulators. The grounding bar will be connected to the GI head using grounding cable. The following items have to be used for grounding systems:

5.1.1 References of Standards

American Standards

ANSI/IEEE/std80	IEEE Guide for Safety in AC Substation Grounding
ANSI/IEEE/std81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Grounding System.

British Standards

BS 1432	Specification for copper for electrical purposes: high conductivity copper rectangular conductors withdrawn or rolled edges.
BS 1433	Specification for copper for electrical purposes, Rod and bars
BS 2871	Specification for copper and copper alloys, Tubes
BS 2874	Specification for copper and copper alloy rods and sections (other than forging stock)
BS 4360	Specification for weldable structural steel
BS 6360	Specification for conductors in insulated cables and cords
BS 6651	Protection of Structures against Lightning
BS 6746	Specification for PVC insulation and sheath of electric cables
BS 7430	Code of Practice for Earthing

International Standards

ISO 427 Wrought copper-tin-alloys - chemical composition and form of wrought productions.

ISO 428 Wrought copper-aluminum alloys - chemical composition and forms of wrought production.

ISO 1187 Special wrought copper alloys - chemical composition and forms of wrought products.

ISO 1137 Wrought coppers (having minimum copper contents of 99.85%) – chemical composition and forms of wrought products

5.1.2 General Requirements

a) Type of electrode: 40mm GI Pipe (Bashundhara Gold or Equivalent).
b) Grounding cable
c) Grounding Plate/Bar (Nickel coated copper) with accessories
d) Water filter (brass)
e) Brick Work covering exposed part of the GI pipe outside the equipment room.
f) Interconnection (using GI pipe of same size as GI electrodes) between electrodes with standard fittings (i.e Union Socket, Tee Socket, Nipple, Elbow, Bend, Short Pipe etc.)
g) Minimum Boring Depth shall be 50 feet to achieve the earth resistance including 10 feet water filter.
h) Number of electrodes per grounding site - minimum 2(two).
i) Separation between electrodes- >50 feet.

5.1.3 GI Pipe

The characteristic of GI Pipes shall be as follows:

i) The pipes shall be welded or seamless, free from dents and internal roughness.
ii) The ends of the pipe shall be reamed to prevent abrasion against cable.
iii) The outside of the pipe ends shall be threaded with a pipe thread.
iv) The pipes shall be jointed together by means of coupler of the same material as the pipes.
v) GI pipe dimension: Diameter: 40 mm, length: 6 m or 20 feet, thickness- 2.30 mm (minimum)

Any disagreement or deviation will be treated as **"Major Deviation".**

5.1.4 Grounding cable

Grounding cable shall be of Single Insulated 50 RM single piece Copper Cable, to be fitted with cable lug, stainless steel nut-bolts and washer at copper bar inside the equipment room. Cable shall be from GI Cable head to the grounding plate/bar at equipment room.

Any disagreement or deviation of the aforementioned clause will be treated as **"Major Deviation".**

5.1.5 GI Head and Grounding Plate

The dimension of the GI Head shall be 125mm x 80mm. There will be at least two numbers of 12mm holes on the GI head. The GI bar shall be of same quality as the GI pipe and it should be galvanized properly.

The Grounding plate/bar shall be 250mm x 80mm x 10mm copper bar coated with nickel. There shall be at least eight numbers of 12mm holes on the grounding bar for termination of grounding cable. The grounding bar will be installed at a suitable place on the wall of the

equipment room at 3~4 inch apart from the wall. The grounding bar and the wall will be separated by two numbers of high-quality insulators.

Any disagreement or deviation of the aforementioned clause will be treated as **"Major Deviation".**

5.1.6 Water Filter

10 feet long water filter made of good quality brass has to be fitted at the bottom of each electrode. Its diameter shall be same as the GI pipe electrodes.

Any disagreement or deviation of the clause will be treated as **"Minor Deviation".**

5.1.7 Brick work (If Required)

Brick work is required for the encasement of the GI pipe while entering into the equipment room. GI pipe will not be visible from outside. There will be 0.25-inch cement plaster on the brick work with paints (Green Color). Bidder shall make holes in the building to run the GI pipe. After installation bidder will repair the holes and paint it properly. Adequate insulation can be done in lieu if brick wall/plaster work.

Any disagreement or deviation of the clause will be treated as **"Minor Deviation".**

5.1.8 Grounding Design

Consideration criterion are as follows:

i) Depth of Electrode: 50 ft each (Including water filter of 10 ft)
ii) No of Electrode: 2 (Two)
iii) Interconnection by GI Pipe at a distance of >50 ft (approximately).

5.1.9 Earth Electrode Design

5.1.9.1 Design Calculations

The design of the earth electrode systems shall be based on the approved earth resistivity data and the system fault currents and their duration.

The design calculations shall be to the approval of the Engineer and shall be based on the methods given in the standards listed. The calculations shall include the following parameters:

i) earth resistance of the whole system and of its components
ii) earth potential rise
iii) step, touch and mesh potentials inside and outside the perimeter fence
iv) requirements for a high resistance surface layer
v) conductor ratings

Earthing points shall be provided such that the combined resistance of the earth grid and all other earthing points does not exceed 1 ohm during the dry season.

The earth potential rises shall not exceed the CCITT limits appropriate to the classification of the system unless special precautions are taken to cater for transferred potentials.

Step, touch and mesh potentials shall be within the permitted limits calculated in accordance with the standards given in IEEE 80 for the proposed surface layer.

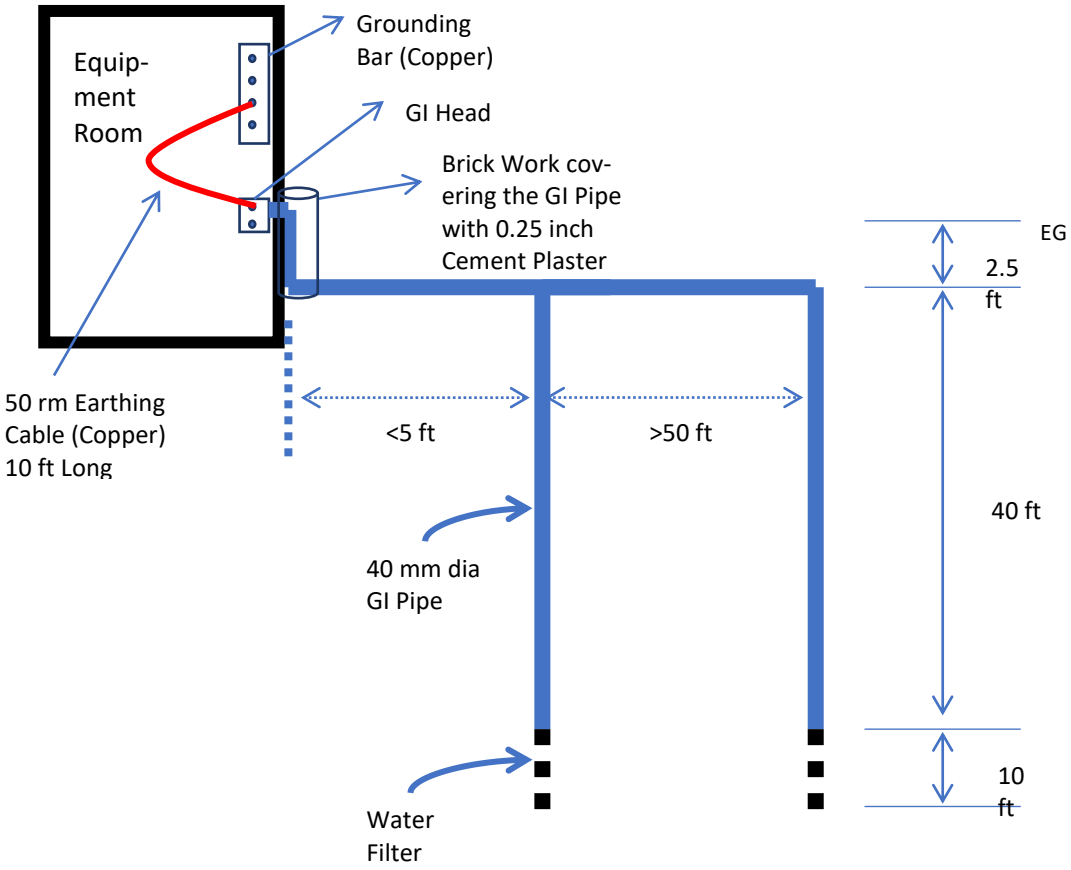

Figure 5.1: Proposed Grounding System Layout

5.1.9.2 Earth Electrode

The earth electrode shall comprise a system of bare conductors forming a mesh buried near the surface of the ground and supplemented, if required, by one or more of the following electrodes: -

i) a system of interconnected rods driven into the ground.
ii) a mesh system of bare conductors buried in the ground.
iii) structural metalwork in direct contact with the ground.
iv) reinforcing steel in buried concrete.
v) a system of bare conductors buried near the surface of the ground outside the perimeter fences.

5.1.9.3 Interconnected Rods

(a) If the design calculations show that a mesh alone is unable to limit the potentials to the required values, then the mesh shall be supplemented by the use of interconnected earthing rods driven into the ground or installed in bored holes.

(b) Rods shall be installed inside the perimeter fence to enclose the maximum possible area compatible with the earthing of any metallic fence. (The spacing between rods shall not be less than their length, unless rating considerations determine otherwise). The copper rod electrodes shall be interconnected in groups

of four to eight rods by insulated copper conductors and non-ferrous clamps to form a ring. Each group shall be connected to the mesh by duplicate insulated copper conductor via disconnecting test links.

(c) Individual rods may be connected directly to the mesh, provided the rod can be disconnected for testing.

(d) Rods installed in bored holes may be used to reach lower resistivity ground strata at depths beyond the reach of driven rods or where rock is encountered and it is not possible to drive rods. After installing the rod, the bored hole shall be back-filled with a low resistivity liquid mixture, which shall not shrink after pouring, to ensure good contact between the rod and the ground for the life of the installation.

(e) The resistance and rating of individual rods and the combined resistance of the groups of rods in the proposed design shall be calculated and the rating of the interconnecting conductors shall not be less than that of the group of rods with a minimum conductor size of 50 RM.

(f) The calculation of potentials in the design of the complete installation shall be made without the group of rods with the lowest estimated resistance to simulate the condition with the group disconnected for testing.

5.1.10 Resistance of grounding system

The net grounding resistance of each grounding set shall be less than 1(one) ohm. The contractor has to make necessary boring and install GI pipe to achieve the required resistance, It is expected that maximum 50 feet per bore may be need for this, which has been shown in the diagram as an example. But the length of electrodes may be more depending on the soil condition of the sites. If electrode length more length than 50 feet is required at any site to achieve the expected grounding resistance, the contractor shall have to consult with project office to get approval.

Any disagreement or deviation will be treated as “**Major Deviation**”.

5.1.11 Direct Stroke Lightning Protection

The Contractor shall provide adequate overhead shielding to effectively prevent direct lightning strikes to any equipment or energized bus within the switchyard areas. The system shall also be designed to provide "effective shielding" to ensure that no insulation flashover can result from atmospheric discharges striking the overhead shielding. The screens shall be of aluminum clad steel wires of not less than 50 sq.mm. total section, and connected to provide low impedance paths to earth.

The lightning protection scheme shall be designed by the Contractor using the latest version of the electro geometric model (EGM) or Razevig method. Detailed calculations demonstrating the adequacy of the proposed shielding shall be submitted to the Employer for approval prior to the overhead shielding design being finalized.

The Contractor may propose a lightning mast and/or shield wire system, however shielding by shield wires is preferred by the Employer. Overhead shield wires shall not make use of "X" patterns & shall not lead to a fault, if broken. Conductor sag shall be

considered when designing the overhead shielding system; however, conductor swing need not be considered.

The overhead earth wire shall be suitable for extension to protect the substation equipment to be installed in future stages of development.

5.2 Glass Partition Enclaved

All Equipment which will be established in PGCB control room, must be enclaved by a tempered glass. The area to be covered will be approximately 6 feet x 6 feet or at actual basis. The bidder will quote for this item at Schedule-D according to the price mentioned in the adjacent column and this will be treated as non-competitive item. If the bidder thinks that, additional cost will be required, then the additional cost should be deemed into the any other sections of price schedules.

5.3 Co-Location Room/ Equipment Shelter

5.3.1 Co-Location Room (Civil Works)

The bidder will build a co-location room of dimension (12ft X 8ft) as per PGCB's requirements. Necessary drawings, layout, BOQ will be proposed by the bidder. PGCB will be free to choose items among the bidder's proposition. After getting approval from PGCB design team, the contractor will be allowed to work as per approved design and BOQ.

5.3.2 Equipment Shelter

The shelter will be made of Pre-fabricated wall and roof panels. The panels assembled with nuts & bolts. Can easily be assembled and disassembled through a knockdown system. Can quickly and easily be installed as well as transported. It can be placed on RCC floor or raised RCC columns. Ent Width of the panel is 4 ft. The equipment shelter should be modular in design with dimension of basic cabinet 12ft X 8ft and expandable 12ft X 8ft. PGCB can build shelter with 12ft x 8ft, 12ft x 16ft, 12ft x 24ft etc.

The shelter has standard internal lighting, cable tray, canopy and roof shade structure.

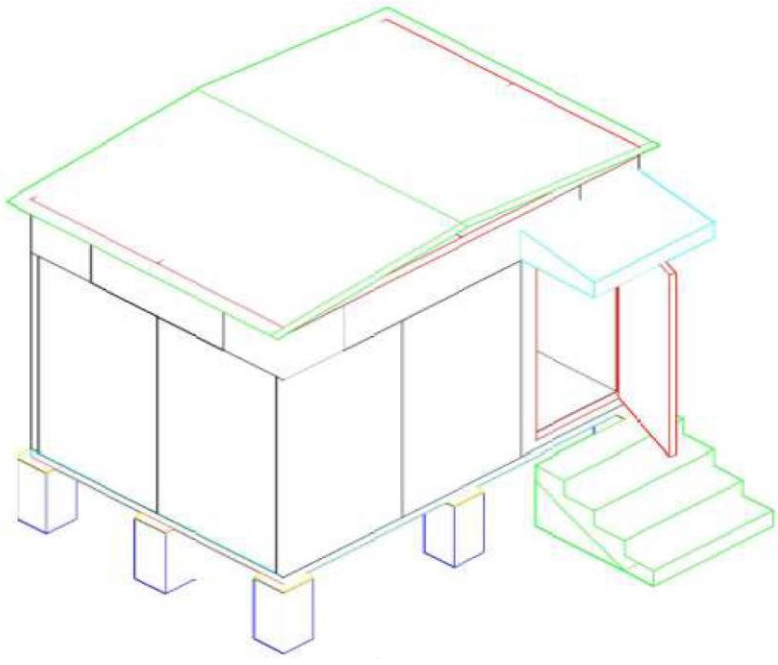

Figure 5.2: Equipment Shelter

i) Shelter structure:

The shelter has a basic floor structure, on top of it floor panel, side wall panel, door panel, roof panel and top shade structure is mounted with nuts & bolts.

ii) Floor panel:

Floor panels are made of square steel frame, PVC top and resinous inside material.

iii) Wall & roof panel:

Wall and roof panels, panel outer part made of steel and inner part of the panel will be made of 0.5in thick plywood. The outside will be finished with powder coating and inside will be finished with 0.1mm thick pasted Formica. The gap between inner and outer part will assembled with steel fixtures and inside part lined with insulation.

iv) Door panel:

Door is mounted in one of the wall panel, size 6 ft X3 ft.

v) Air Conditioner:

Each 12 ft x 8 ft shelter module should include 2x2 ton split air conditioners with automatic switch over in every 4 (FOUR) hours. ODU of A/C to be fitted with fixture with safety grill.

vi) Other accessories:

The shelter should include with internal electric wiring, internal cable tray etc. to fulfil the requirement of telecom installation.

vii) The shelter should include foundation work, earth excavation, ramming, brick soling, CC work, brick work, floor casting with RCC. Etc including transportation and installation at site.

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.4 Air Conditioner

5.4.1 Technical Particulars of Air Conditioner

The bidder must supply adequate air conditioners as per schedule mentioned in Section 1 of Volume 3 whereas, the air conditioner must meet the following specifications:

CAPACITY (BTU)	24000 BTU
COOLING CAPACITY (KW)	6.5~6.8
POWER SUPPLY (V-PH-HZ)	220V – 240
POWER CONSUMPTION	2500 – 2650
VOLTAGE RANGE (V)	198-264
Operating current	5.4~5.8
REFRIGERANT	R410A
SERIES	Wall Mounted Split Air Conditioner
AUTO RESTART FUNCTION	Yes
POWERFUL JET	Yes
AUTO SWING LOUVER	Yes
AUTO OPERATION MODE	Yes
ON/OFF TIMER	Yes
Noise (Indoor Unit) (dB)	≤ 41
Noise (Outdoor Unit) (dB)	≤ 46

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.4.2 Brands and Assembling Country

Carrier/ General/ Sharp/ Samsung/ Haier/ Singer/ Transcom/ LG/ Whirlpool or equivalent. (Assembled in Thailand/ Malaysia/ Taiwan/ Korea/ Japan/ USA/ EU Countries)

The bidder can also propose any Bangladeshi brand which is equivalent to the afore-mentioned brands.

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.5 Underground Optical Fiber Cable (OFC)

5.5.1 Underground Optical Fiber Cable (OFC)

The bidder's proposed OFC must meet the following specifications:

5.5.1.1 Optical Fiber

Parameters	Specification
i) Standard	ITU-T 652D
ii) No of Fiber Cores	48
iii) MFD (1310nm)	9.2+/-0.4um
iv) MFD (1550nm)	10.4+/-0.5um
v) Cladding diameter	125μm±1.0μm
vi) Fiber diameter	245+/-7um, with UV coating, and colored to :250+/-15um
vii) Core/cladding concentricity error	≤ 0.6um
viii) Coating/cladding concentricity error	≤ 12.0um
ix) Cladding non circularity	≤ 1.0%
x) Cut off wavelength	λcc ≤1260nm
xi) Attenuation coefficient	1310nm: 0.35dB/km max after cabling
	1550nm: 0.21dB/km max after cabling
xii) Bending-loss performance of optical fiber @1310nm & 1550nm	≤0.05dB (100 turns around a mandrel of 50mm diameter)
xiii) Polarization mode dispersion link value	≤0.1ps/√km
xiv) Zero-dispersion wavelength	1312+/-12nm
xv) Zero- dispersion slope	≤0.091 ps/nm^2.km

5.5.1.2 Mechanical and Environmental Performance

Item	Value
i) Tensile performance(N)	3000
ii) Crush(N/100mm)	3000
iii) Static bending radius	12.5 times the cable diameter
iv) Dynamic bending radius	25 times the cable diameter
v) Operation temperature	-40˚C~+70˚C
vi) Installation temperature	-40˚C~+70˚C
vii) Storage temperature	-40˚C~+70˚C

5.5.1.3 Dimensions and Descriptions

Item	Contents	Value
		48
i) Loose tube	Number	4
	Outer diameter (mm)	2.2
ii) Filler	Number	2
iii) Max, fiber counts per tube	G.652D	12
iv) Central Strength member	Material	FRP
	Diameter (mm)	2.25
	PE layer diameter (mm)	-
v) Water Blocking Material	Material	Cable Filling compound
vi) Wrapping	Material	Polyester tape
vii) Inner sheath	Material	HDPE
	Color	Black
	Thickness (mm)	Normal: 1.0
viii) Armor	Material	Steel tape
ix) Outer sheath	Material	HDPE
	Color	Black
	Thickness (mm)	Normal: 2.0
x) Ripcord	Number	2+2
xi) Cable diameter(mm) Approx.		14.4
xii) Cable weight(kg/km) Approx.		190

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.5.2 All Dielectric Self Supporting (ADSS) Optical Fiber Cable

The bidder's proposed fiber optic cable must meet the following specifications. Bidder shall consider tower to tower span at around 350 meters for deployment of ADSS.

5.5.2.1 Optical Fiber

Parameters	Specification
i) No of Fiber Cores	48
ii) MFD (1310nm)	9.2+/-0.4um
iii) MFD (1550nm)	10.4+/-0.5um
iv) Cladding diameter	125µm±1.0µm
v) Fiber diameter	245+/-7um, with UV coating, and colored to :250+/-15um
vi) Core/cladding concentricity error	≤ 0.6um
vii) Coating/cladding concentricity error	≤ 12.0um
viii) Cladding non circularity	≤ 1.0%
ix) Cut off wavelength	λcc ≤1260nm
x) Attenuation coefficient	1310nm: 0.35dB/km max after cabling
	1550nm: 0.21dB/km max after cabling
xi) Bending-loss performance of optical fiber @1310nm & 1550nm	≤0.05dB (100 turns around a mandrel of 50mm diameter)
xii) Polarization mode dispersion link value	≤0.1ps/√km
xiii) Zero-dispersion wavelength	1312+/-12nm
xiv) Zero- dispersion slope	≤0.091 ps/nm^2.km

5.5.2.2 Loose Tube

Item	Construction
i) Cable type	Loose Tube Stranded, Dry core, Aramid Yarn Armored, Single Sheath, Self-Supporting (ADSS) OFC.
ii) Loose tube materials	PBT (Polybutylene Terephthalate)
iii) Loose Tube Filling Compound	Thixotropic Jelly
iv) Core Filling	Dry Core
v) Armoring materials	Aramid Yarn Armored
vi) Central Strength Member (CSM)	FRP (Fiber Reinforced Plastic)
vii) Outer Sheath Material	Black Polyethylene (MDPE)
viii) Outer Sheath Thickness	1.8 ± 0.2 mm
ix) Number of fiber per Loose Tube	12 for 48F
x) Number of Loose Tube	4 for 48F
xi) Filler Rod	2 Nos.
xii) Cable Diameter	11.0 ± 0.3 mm
xiii) Drum Type	Wooden Drum
xiv) Length	2-4 km/drum ± 10%
xv) Weight	90 ± 10 kg/km
xvi) Marking	Length Marking: at intervals of every single meter Number of Fibers in the cable Year of manufacture & Name of Manufacturer.

The bidder shall quote for the ADSS Cable in Schedule B7, Volume 3, which will be provided to PGCB for future planning purpose (if Required). The price in Schedule-B7 will not be included in Schedule-B5 (Grand Summary). If, PGCB becomes interested during project period or later after, the bidder will have to provide the asked item on that price.

5.6 Optical Distribution Frame (ODF)

i) The optical distribution / termination frame shall be rack (19 inches. Standard Rack or equivalent any other standard) mounted type and will be installed in suitable position in the equipment room.

ii) Optical Links in the optical distribution / termination frame shall be high grade SC/FC type.

iii) There shall be easy access for splicing and provision for maintenance facility.

iv) There shall be provision for cable entry either from above or from the left-hand side, allowing the station cable to enter the bay either from above or below.

v) The capacity of the optical distribution/termination frame shall be 24/48/96 single fibers. The surplus fibers shall be curled up in splice tray for easy access. The tray shall hold sufficient fiber length to able not only fusion splicing but also reopening and re-splicing of any fiber if needed in futures.

vi) There shall be provision for inspection or cleaning the internal fiber connectors.

Bidders will offer ODF to PGCB as per requirements mentioned in Schedule A of Volume 3.

If the offered optical distribution / termination frame fails to meet the capacity and technical requirements as mentioned above, then for each deviation/disagreement of each sub-clause of clause-5.5 will be considered as "**Major Deviation**".

5.7 Patch Chord

a) The Bidder shall quote following Patch Chord with **SC/PC connectors** at one end and **LC connector** at the other end.

i) 2 meter: as per schedule of requirements
ii) 5 meter: as per schedule of requirements.
iii) 10 meter: as per schedule of requirements.
iv) 20 meter: as per schedule of requirements.
v) 30 meter: as per schedule of requirements.
vi) 50 meter: as per schedule of requirements.

b) The Bidder shall quote following Patch Chord with **FC/PC connectors** at one end and **LC connector** at the other end.

i) 2 meter: as per schedule of requirements
ii) 5 meter: as per schedule of requirements.
iii) 10 meter: as per schedule of requirements.
iv) 20 meter: as per schedule of requirements.
v) 30 meter: as per schedule of requirements.
vi) 50 meter: as per schedule of requirements.

c) The Bidder shall quote following Patch Chord with **SC/PC connectors** at one end and **FC/PC connector** at the other end.

i) 2 meter: as per schedule of requirements
ii) 5 meter: as per schedule of requirements.
iii) 10 meter: as per schedule of requirements.
iv) 20 meter: as per schedule of requirements.
v) 30 meter: as per schedule of requirements.
vi) 50 meter: as per schedule of requirements.

d) The Bidder shall quote following Patch Chord with **FC/PC connector** at both ends.

i) 2 meter: as per schedule of requirements
ii) 5 meter: as per schedule of requirements.
iii) 10 meter: as per schedule of requirements.
iv) 20 meter: as per schedule of requirements.
v) 30 meter: as per schedule of requirements.

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.8 Optical Pigtail

The Bidder shall quote single mode optical pig tail with SC/PC and SC/FC connectors with all the ODF sets.

Any disagreement or deviation of the clause will be considered as **"Major deviation"**.

5.9 Universal Joint/Splice Closure Kit

The Bidder shall use Universal Joint/Splice Closure Kit if required which must fulfil the following criterion. Cost of this item is deemed to be included in the contract.

i) The splice closer shall be waterproof type, which will accommodate the joint part of the cable, should be suitable for installation in manhole or hand hole or be directly buried.

ii) Fiber splice tray/holder shall be provided inside the closure to accommodate the splice protector and surplus length of fiber after splicing.

iii) The material of the sleeve for the closer shall consist of plastic material containing the glass fiber. The metal material for the closer shall be anti-corrosive & anti-rusting.

iv) The closer shall have the following characteristics:

a. No leakage of air for 24 hours after applying 0.5 ± 0.1 kg/cm gas pressure.

b. No invasion of water after 1 hour with 1.0 ± 0.1 kg/cm water pressure.

c. No malfunction for 1 minute at 1500 VDC between metal core and closer surface.

v) Splice closures should be easy to open with the no special or specific tools and should he reusable without the necessity of cable cutting.

vi) The joint closure must be 4 way. It should be possible to make 4 way interconnection to different directions with the closure.

vii) Adequate number of Tray / Cassette shall be provided to hold minimum 24 fiber splices inside each joint closure.

viii) Full technical and constructional details of the closure are to be given along with the Bid.

Any Disagreement/deviation from each sub-clause will be considered "**Major Deviation**".

SECTION 6

Test Instruments

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SECTION 6

Test Instruments

6.1 General

Bidder shall propose test equipment and special tools for Optical Fiber splicing for installation, operation and maintenance of the optical fiber network. The bidder shall quote the number of quantities as mentioned in schedule BoQ.

i) All test equipment shall be from well-reputed manufactures with guarantee for calibration and repair maintenance services preferably in Bangladesh for a period of 10 years from the date of signing of agreement.

ii) The contractor shall supply original complete software in CD including operating system, Instruction, Operation and User manuals for the test equipment.

iii) The contractor must submit document/brochure of test equipment with adequate technical details and offer must be clearly mentioned which module and software option had been included in the offer, so that PGCB clearly evaluate whether the offer meets PGCB specification.

iv) The technical specification of the proposed test equipment shall be at least exactly similar or better than these mentioned in the technical specifications of the specified test equipment in aforementioned clauses. It should be noted that, test equipment is very vital for maintenance, so quality shall not be compromised for any proposed test equipment.

v) The contractor will be liable to provide practical training session about the know-how of this equipment.

Any Deviation/disagreement of each of aforementioned clauses shall be considered as "**Major Deviation**"

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6.2 Optical Time Domain Reflectometer (OTDR)

The required Optical Time Domain Reflectometer shall be Viavi MTS-6000 or Equivalent or better or new version of the specified model. It shall be Long Ranged and Plug-in Module with both FC and SC interfaces. The features and the specifications are given below.

(a) Main Characteristics:

Wavelength	1310nm to 1550nm
Span	0.1km to 200km
Dynamic range	40 dB minimum
Internal memory capacity	At least 250 traces.
Display	TFT Color, 8.4 in LCD, 88x600, high-visibility
Output Power at source mode	-3.5 dBm
Power level (Power meter mode):	+10 to -69 dBm
Optical connector type	Both FC and SC (Field interchangeable)
Input Power	100 – 240 volt AC, 50Hz – 60Hz
Internal Battery	Re-chargeable Li ion type
Battery back-up	Minimum 6 hours
Laser safety	Class 1M laser
Environment	Temperature: 0o-40^{o}C,
Humidity	Max 95% non-considering

(b) Operating Modes:

i) OTDR Mode
ii) Fiber break locator mode
iii) Source mode
iv) Power meter mode

(c) Others:

All other essential hardware and software for successfully operating and maintaining the test equipment shall also be the part of the specification of the proposed test equipment.

The bidder shall quote the price of the test equipment as per Schedule A.

6.3 Light Source

The proposed light source shall be of Viavi OLS-35 model or equivalent model of world renowned North American/European Union/Japanese brand. The proposed equipment shall satisfy following minimum requirements:

i)	Mode	:Single mode light source
ii)	Source type	:LASER
iii)	Wavelength	:1310 & 1550 nm
iv)	Spectral width	:< 5 nm
v)	Output Power	:- 7 dBm or more
vi)	Short term stability	: ± 0.02 dB
vii)	Long term stability	: ± 0.05 dB
viii)	Optical Interface Connector	: FC/SC

The bidder shall quote the price of the test equipment as per Schedule A.

6.4 Optical Power Meter

The required light source shall be of Viavi OLP-34 model or equivalent model of world renowned North American/European Union/Japanese brand. The proposed equipment shall satisfy following minimum requirements:

i)	Detector type	:Germanium/InGaAs
ii)	Wavelength Range	:800 to 1600 nm
iii)	Calibrated wavelengths	:850, 980, 1300, 1310, 1490 & 1550 nm
iv)	Power Range	: -60 to +5 dBM
v)	Display Range	:-60 to +10 dBm
vi)	Maximum input power	:+10 dBm or more
vii)	Measurement units	:dB/ dBm/ W
viii)	Absolute Uncertainty	: ± 0.2 dB
ix)	Linearity	: ± 0.06 dB (-50 to +5 dBm)
x)	Optical Interface/ Connector	: Universal 2.5 mm/1.25 mm

The bidder shall quote the price of the test equipment as per Schedule A.

6.5 Fusion Splicing Machine

The proposed fusion splicing machine shall be FUJIKURA Model FSM-80S or Equivalent or better or new version of the specified model along with fiber optic cleaver [FUJIKURA Model CT-30 (or later model) Series or Equivalent or better or new version of the specified model], stripper and other accessories. The following features of the fusion splicing machine shall be included:

i)	Applicable to Any Optical Fibers	
ii)	Fiber count	Single
iii)	Type of fiber	SM (ITU-T G.652 & G.657) MM (ITU-T G.651) DS (ITU-T G.653) NZDS (ITU-T G.655)
iv)	Fiber dimensions	
	Cladding diameter	80 to 150 μm With standard fiber clamp
	Coating diameter	100 to 1000 μm
	Cleaved length	5 to 16mm with coating diameter of 250 μm or less 16mm with coating diameter of 250 to 1000 μm
v)	Splicing Modes / Tube Heating Modes / Display language: Splicing mode	
	AUTO	Automatic fiber identification (SM/MM/DS/NZDS)
	MM	Single mode fiber (ITU-T G.652 & G.657)
	DS	Multi-mode fiber (ITU-T G.651)
	NZDS	Dispersion shifted fiber (ITU-T G.653)
	AT1 / AT2	Attenuation splices modes
	AT1 / AT2	Manual splicing mode
vi)	No. of splicing mode	100 modes (programmable 40 / data base 60)
vii)	Actual average splice loss	0.02dB with SM, 0.01dB with MM, 0.04dB with DS & NZDS
viii)	Splice time	7 sec: SM Fast mode, 12 sec: SM Auto mode, 15 sec: Auto mode
ix)	Return loss	60 dB or higher
x)	Tube heater	Built-in auto start tube heater with 10 heating modes
xi)	Tube heat time	13-15 sec with FP-03 protection sleeve.
xii)	Applicable protection Sleeve length	60mm, 40mm
xiii)	No. of splice/heating Per battery full charge	Typical 200 cycles with BTR-09
xiv)	Electrode life	3000 arc-discharges
xv)	Display language	English
xvi)	Monitor / Viewing Method	4.73 inch color LCD monitor
xvii)	Magnification	X / Y (320X magnification), or both X and Y simultaneously (200X magnification)
xviii)	Storage of Splice Results	No. of splice memory : 2000 splices in internal memory
xix)	Power Supply	Auto volt selection from 100 to 240V A/C with ADC- 18 14.8 V D.C with BTR-09
xx)	Operating conditions	-10 to +50 degree C
xxi)	Humidity	0 to 95% RH (Non-dew)
xxii)	Wind protection	Up to 15m/s (33mph) wind velocity
xxiii)	Other accessories	AC adapter, AC power cord, Carrying case, Spare electrodes (1 pair), In-struction manual, USB cable, Sleeve loader, Alcohol pot, Screw driver etc.

The bidder shall quote the price of the test equipment as per Schedule A.

6.6 Special Tools Kit

Special tools packed in a transportable tool case for jointing the optical fiber cable shall be provided. Detailed list of tools shall be submitted with the bid include the following items as a minimum:

i) Transit Case.
ii) Measuring Tape.
iii) Fiber Stripper (250µ).
iv) Buffer Tube Stripper (250µ).
v) Automatic Screwdriver (Slotted and Star).
vi) Pliers and Cutter.
vii) Hand-Held Metallic Fine Raspier.
viii) Cable Sheath Stripper.
ix) Heat gun.
x) Allen Key Set
xi) Cable Tie Gun Set.
xii) F/O Knife.
xiii) Fiber cleaning kit

The bidder need not to quote for these aforementioned items. It will be considered to be deemed in to the contract.

SECTION 7

Training, Testing and Different Services

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SECTION 7

Training, Testing and Different Services

7.1 Survey, Network Planning & Design

i) The Contractor shall be responsible to provide all services related to installation survey, planning & design for all equipment/system covered by this purchase. After signing the purchase contract, a survey shall be conducted by the contractor where PGCB will arrange all sorts of access available for the survey work.

ii) The contractor shall be responsible for planning & designing based on the survey data. Before installation of the equipment, the contractor shall submit the Installation design and drawing along with survey report to the project office for approval. Installation shall be carried out as per the approved design and drawing. No modification of design is allowed without prior approval of the project office.

iii) Only the successful Bidder/contractor shall be responsible to provide all services related to installation survey, planning & design for all OSP covered by this purchase. After issuance of letter of intent to the successful bidder and subsequent submission of Performance Guarantee a survey shall be conducted jointly by the successful bidder and PGCB.

iv) The bidder shall be responsible for planning & designing based on the survey data. All relevant documents related to such exercises shall be submitted to PGCB. Upon receipt of those documents, PGCB shall start BOQ negotiation with the bidder. PGCB will have the full right to customize the BOQ as per requirement.

v) The bidder shall quote cost of such survey planning and designing separately. The bidder shall show details of such service including methodology of fixing charges for such service for any subsequent expansion of the network.

vi) All costs for materials and service shall be quoted and failure to quote shall be considered that the bidder proposes to provide this service totally "free of charge" to PGCB.

Any disagreement will be treated as “**Change of substance**”.

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7.2 Installation, Testing and Commissioning Services

i) The Bidder shall be responsible to provide all services related to installation, testing, commissioning and cut-over services for all equipment covered by this purchase. The quality and workmanship of the installation works must be of international standard. Any non-standard installation will be rejected by PGCB during implementation of the project or during PAT of the equipment. PAC of the equipment will not be issued until the non-standard installation, if identified during PAT, is not corrected. The Bidder, in his offer, shall show details of required installation and commissioning services, for each equipment separately, per site, to come to a total price for “Installation and Commissioning Services”.

ii) These price breakdowns will be used for calculating revised total price if there is any subsequent change in number of sites and/or amount of equipment.

iii) If the bidder fails to give detail breakdown, PGCB shall reserve the right to draw its own conclusions, as and where necessary.

All costs for service shall be quoted and failure to quote shall be considered that the bidder proposes to provide this service totally "**free of charge**" to PGCB.

7.3 Training

The Bidder shall provide the training to PGCB Engineering personnel. The curriculum shall be enough to facilitate transfer of technology for planning, designing, expanding and proper operation & maintenance of all the systems covered by this purchase to PGCB engineering personnel. Bidder shall include total price for the Training in his offer. Failure to quote shall be considered that the bidder proposes to provide this service totally "**free of charge**" to PGCB.

7.3.1 Training at the Manufacturer's premises

The following generic areas should be included in the training program. Actual content of each item should, however, be customized to match with the architecture and solutions offered by the bidder.

Introduction to DWDM technology, Operation and Maintenance of the proposed DWDM Optical transmission system including features and technical specifications of the offered DWDM equipment, Proposed network configuration, Practice in the DWDM equipment, the NMS/EMS/CIT practice etc.

Detail of the Factory training for DWDM Equipment and system is as follows:

i) Number of PGCB Engineers: 06 (Six)

ii) Number of working days: 10 (ten) [Excluding Travel Time and Holidays in between]

iii) Per Diem charge to PGCB Trainee: USD 100 (One hundred) per day per person for each calendar day including all holidays in between and travel/airport transit days.

iv) Other facilities: Both way air ticket (economy class), Accommodation including foods, local transportation, and medical facility (if required).

7.3.2 Local Training at Dhaka

The Training should be arranged in manufacturer's local office. If there is no local office of the manufacturer in Dhaka then, it can be arranged in any good training center/hotel etc. The following generic areas should be included in the training program. Actual content of each item should, however, be customized to match with the architecture and solutions offered by the bidder.

Introduction to DWDM technology, Operation and Maintenance of the proposed DWDM Optical transmission system including features and technical specifications of the offered DWDM equipment, proposed network configuration, Practice in the DWDM equipment, the NMS/EMS/CIT practice etc.

Detail of the local training for DWDM Equipment and system is as follows:

i) No of Training batches: 02 (Two)
ii) Number of PGCB Engineers: 10 (ten) in one batch.
iii) Number of working days: 15 (fifteen)
iv) Per Diem charge to PGCB Trainee: BD Taka 1,000 (one thousand) per day per person for each working day.

7.4 Factory Acceptance Test (FAT)

Testing at manufacturer's premises, to be termed as "**Factory Acceptance Test (FAT)**", shall be carried out (on random sampling basis) for all type of DWDM/OTN/ DC Power System equipment to be supplied under this purchase. The FAT shall include all tests as per relevant ITU-T and/or other relevant recommendations. PGCB will send its' Representative for every lot of equipment to be shipped by the successful bidder. No shipment is allowed before FAT. Each FAT must be executed on the presence of PGCB engineers at the manufacturer's own production factory. No product will be accepted except successful FAT. Detail of the FAT for first lot of equipment is as follows:

7.4.1 FAT For all type of OTN/DWDM equipment and NMS

i) No. of PGCB Engineers: 03 (Three)
ii) No. of working days: 07 (Seven) (Excluding Travel Time)
iii) Per diem charge for the PGCB inspectors: USD 100 (One hundred) per person for each calendar day including all holidays in between and travel/airport transit days.
iv) Other facilities: Both way air ticket, Comfortable Accommodation including meal, local transportation and medical facility (if required).

7.4.2 FAT for DC Power System Equipment (Battery/ Charger/ Inverter)

This FAT will be arranged by the contractor for all DC power system accessories (Battery/ /Rectifier/ Inverter)

i) No. of PGCB engineers: 03 (Three)
ii) No. of working days: 07 (Seven) (Excluding Travel Time)
iii) Per diem charge for the PGCB inspectors: USD 100 (One hundred) per person for each calendar day including all holidays in between and travel/airport transit days.
iv) Other facilities: Both way air ticket, Comfortable Accommodation including meal, local transportation and medical facility (if required).

For both of the FAT mentioned above, the contractor will submit the FAT format to PGCB once the manufacturer's equipment is ready for shipment and arrange FAT where all the tests to be done according to the PGCB approved FAT format.

7.5 Provisional Acceptance Test (PAT)

i) Before acceptance of the installed system/ equipment, PGCB representatives/consultant shall carryout, on site, detailed tests of all equipment to ascertain their working reliability, concurrence to agree technical and other specifications, inter-working ability with relevant equipment of the other manufacture, inventory checking of installed equipment etc. Such tests shall be termed as "**Provisional Acceptance Test (PAT)**". Prior to commencement of such tests, the contractor shall submit a proposed procedure for the PAT at least 1 (one) month before PAT to be subsequently approved by the concerned Project Director/ Design Depart-

ment of PGCB. The contractor shall be solely responsible for the test and the test results. The PAT will be done by a joint team of PGCB Engineers and Contractor's Engineers.

ii) On completion of installation and self-testing of any system/ equipment, the Contractor shall submit 3 (three) copies of self-test results to PGCB and offer that system/ equipment for PAT. PGCB shall start such test within one month upon receipt of the complete request. The contractor may, upon agreement by the both parties, offer PAT for any part or parts of the total system. Such request for partial PAT may also be asked for by PGCB.

iii) The contractor shall provide testing instruments, equipment, tools, test gears required for such test and take back above-mentioned things after completion of such tests. PGCB, except where otherwise specified, shall provide, electricity, generator fuel and water free of charge, as may be required and as may be reasonably demanded by the contractor to carry out such tests efficiently, when such tests are being carried out at PGCB premises.

iv) The contractor's engineer shall be liable to make necessary arrangement to complete any kinds of tests requested by PGCB PAT members during PAT.

v) In addition, the contractor shall have to provide per diem costs to PAT engineers as per the following:

a) Number of PGCB's PAT Engineers for all equipment sites covered by this purchase: At least 02 (Two) and Maximum 03 (Three) in 01 (one) team.

b) PAT Team will be formed by 01 (One) Executive/ Superintending Engineer, 01 (one) Assistant/Sub Divisional Engineer, 01 (one) Sub-Assistant Engineer or according to the guidelines of Project Director.

c) Number of days allowed for per diem charge for each person: 02 (Two) working days per site

d) Per diem charge to PGCB's PAT Engineers: Taka 1,500 (Fifteen Hundred) per person per day.

e) Other facilities: Transportation to the site and any other facilities related to PAT.

However, the bidder shall note that, if necessary, any or all PAT can continue for more than the above scheduled period; but, in such case, the bidder shall not be liable to pay per diem for those additional days.

vi) The contractor shall notify PGCB in writing of the commencement date of the PAT. Such a notification shall be issued at least 15 (FIFTEEN) working days prior to the suggested date of PAT. The contractor shall submit the self-test results of the sites proposed for PAT to the convener of the PAT team at least 7 (seven) days before the proposed commencement date of PAT. PGCB will not accept the PAT report and issue PAC on the basis of the PAT report submitted by the contractor if there is any test performed in absence of PGCB Engineers.

vii) After successful completion of the PAT, the PAT committee members shall submit the signed PAT report to the Project Director within 15 (FIFTEEN) workings days of completion of PAT. If PAT is not successful due to any major defect or major deficit which may affect the performance of system/equipment substan-

tially or deviates substantially from the agreed technical specification(s), the convener of the PAT committee will report the matter to the Project Director in writing along with the cause(s) of unsuccessful PAT within 7 (SEVEN) working days from the day of finding the cause(s) for which the PAT is unsuccessful and will give a copy of the written notification to the contractor.

viii) Within 15 (FIFTEEN) working days from the date of the submission of the PAT report by the PAT committee as per sub-clause (vi) above, the PAC shall be issued by PGCB or PGCB shall notify the contractor the valid reason of not issuing the PAC. The PAC will be made effective from the date of completion of the PAT.

ix) Minor defects or minor deficits described in the PAT report not affecting substantially the operational use of the system/equipment/Works shall not give rise to rejection of the system/equipment/Works concerned. In such case, the PAC shall be issued within 15 (FIFTEEN) working days from the submission of PAT report, with effect from the date of completion of the PAT. The contractor shall take prompt action to make remedy of such defects and/or deficits within 03 (THREE) months from the date of issuance of the PAC.

x) The contractor shall make remedy of all the Major defect(s) or major deficit(s) affecting substantially the operational use of the system/equipment/works or of any major deviation from the agreed technical specifications mentioned in the written report of the convener of the PAT committee as mentioned in sub-clause (vii) above, within a mutually agreed period of time. After completion of the remedies, the PAT shall be re-conducted at the written request of the contractor. The major defects or major deficits or major deviations described in the report of the convener of PAT committee shall be re-tested and, if required, other directly related test(s) can be re-conducted.

If in any case, PGCB put the equipment or system/equipment/Works with major defects/deficits/deviations into partial or total use/operation for business purpose, PAC shall be issued as per sub-clause (ix). However, the issuance of such PAC shall not relieve the contractor from making remedy of the major defects/deficits/deviations and the contractor will make remedy of the major defects/deficits/deviations within 6 (Six) months from the date of commercial use/operation.

xi) There shall be no partial or total use or commercial launching of the System/equipment/Works by PGCB prior to PAT. However, if any such partial or total use or commercial launching of the system/equipment/Works occurs, PGCB shall be deemed to have accepted the system/equipment/Works concerned, and the PAC of such system/equipment/Works shall be issued within 15 (FIFTEEN) working days from the date of use or commercial launching, with effect from the date of use or commercial launching. If, within the elapse of such 15 (FIFTEEN) working days, PGCB does not issue the PAC, the contractor shall issue a notification letter to PGCB claiming issuance of PAC. If PGCB does not issue the PAC within 7(seven) working days from the receipt of the notification letter then the notification letter shall be deemed as PAC, with effect from the date of use or commercial launching.

However, in such case, PAT shall be conducted within 15 (Fifteen) days after the date of use or commercial launching and the contractor shall be liable to make remedy of any defect/deficit/deviation if identified during such PAT.

xii) Before performing PAT, the contractor shall prepare PAT document, detailed BoQ along with as-built drawing for each site. PAT Team shall make physical verification of the BoQ.

xiii) The contractor shall deliver the equipment as per the approved Implementation Schedule. If the equipment cannot be installed as per the Implementation Schedule due to the reasons attributable to PGCB, the contractor shall issue a notification letter requesting PGCB to take over the equipment immediately. If within 30 (THIRTY) days from the issuance date of such notification letter, the equipment is not handed over, such notification letter shall be deemed as PAC, with effect from the issuance date of such notification letter. But such deemed PAC shall not relieve the contractor from the responsibility of installing the equipment and conducting PAT.

The contractor shall install this equipment, if any, only before Completion Date of the contract. Upon installation, PAT of the equipment will be conducted and the contractor will make remedy of all the defects/deficits/deviations, if found during the PAT. If the equipment functions normally, the guarantee period shall be 02 (Two) years counting from the date of deemed PAC.

xiv) The contractor shall develop the Software system according to the approved Tender documents/BOQ of PGCB, and PGCB shall conduct the PAT as per the approved Tender documents/BOQ after the system has been delivered. Any additional feature of the system which is not included in the Tender document shall not affect the conduct of PAT and the issuance of PAC.

xv) The contractor shall hand over the items listed in BoQ to representative(s) of PGCB during the PAT or the start of commercial operation (whichever comes earlier). The handing over document shall be signed by representative(s) of both Parties.

xvi) The deemed PAC shall have the same force and effect as the PAC. The deemed PAC shall not relieve the contractor's responsibility of installing, testing and commissioning such Equipment within 24 (Twenty-Four) months from the issuance of PAC.

All costs for materials and service (if any) shall be quoted and failure to quote shall be considered that the bidder proposes to provide this service totally **"free of charge"** to PGCB.

Any disagreement of clause 7.5 or sub-clause will be treated as "**Change of substance"**.

7.6 Final Acceptance Test

i) After completion of the PAT and cut-over of the respective systems, the Engineers of the Contractor will take prompt necessary steps to remove all types of faults and replace all types of faulty equipment at the cost of the contractor. At the end of the "**Performance Guarantee Period**" for the respective systems, the overall performance of all equipment will be reviewed and this review shall be termed as "**Final Acceptance Test**".

ii) The review shall include the required working reliability and performance standards of the equipment to meet tender specifications, the contractor's responsiveness to resolve all shortcomings mentioned in PAT reports and the contractor's removal of all pending & outstanding faults or shortages encountered during the Performance Guarantee Period for the Contract. When this "Final Acceptance Test" becomes due, the contractor shall make an official request to PGCB for starting of the test and PGCB shall start the "Final Acceptance Test" within 15 (FIFTEEN) working days after receipt the request from the contractor.

iii) The contractor shall be responsible for arrangement of all equipment, consumables, test gears and measuring equipment required (if any) for such review tests. All cost for material and service shall be borne by contractor.

iv) In addition, the bidder shall have to provide per diem costs to "Final Acceptance Test" engineers as per the following:

a) Number of PGCB's "Final Acceptance Test" Engineers for all equipment sites covered by this purchase: 02 (Two) in 1 (one) team.

b) Number of days allowed for per diem charge for each person: 1 (one) working day per site

c) Per diem charge to PGCB's Engineers: Taka 1,500 per person

d) Other facilities: Transportation to the site and any other facilities related to Final Acceptance Test.

v) However, the bidder shall note that, if necessary, any or all "Final Acceptance Test" can continue for more than the above scheduled period; but, in such case, the bidder shall not be liable to pay per diem for those additional days.

vi) When the FAT becomes due, the contractor shall make an official request to PGCB to start "Final Acceptance Test" and PGCB shall start "Final Acceptance Test" within 15 (FIFTEEN) working days from the date of receipt of the contractor's request. The "Final Acceptance Test" committee of PGCB shall complete all the reviews mentioned in clause 7.6 (ii) in collaboration of the contractor and submit a "Final Acceptance Test" report within 30 (THIRTY) working days from the date of start of the "Final Acceptance Test".

vii) If any defect in Equipment, Software or in installation is detected during "Final Acceptance Test", this shall be noted down in the test report. This defect must be removed by the Supplier, before issuance of FAC. Without resolving the raised issue, FAC will not be issued. Purchaser will issue the FAC within 15 (Fifteen) days of successful completion of "Final Acceptance Test".

viii) In spite of successful “Final Acceptance Test” and report signed by both the parties, the Purchaser has not issued the FAC within 15 (Fifteen) days, FAC shall be deemed to have been issued by PGCB in all respect and the contractor may claim payment by issuing Payment Claim Letter for the said part.

All costs for materials and service (if any) shall be quoted and failure to quote shall be considered that the bidder proposes to provide this service totally **"free of charge"** to PGCB.

Any disagreement of clause 7.6 or sub-clause will be treated as **“Change of substance”**.

7.7 Inter-connection between different ODFs

The Contractor shall be responsible for making inter-connection facility (including supply of all required material, optical fiber cables, connectors at both ends of inter-connecting cable and related service) between their installed DWDM/OLA equipment and PGCB’s or PGCB’s existing/new Transmission ODFs at all sites. The bidder shall note that optical connectors at all existing ODFs of PGCB are of FC type or SC type. The Bidder may consider the maximum length of optical patch cord for interconnection as per actual survey. All costs for materials and services in this regard shall be quoted by the bidder in his offer. Failure to quote shall be treated as “**non-compliance**” and it shall be considered that the bidder proposes to provide this "**free of charge**" to PGCB.

Any disagreement of clause 7.7 or sub-clause will be treated as “**Change of substance**”.

7.8 Balancing, Integration and Configuration of supplied equipment/ system

The Contractor shall be responsible for executing the submitted Balancing, Integration and Configuration Plan (revised plan after BOQ finalization). The bidder shall be responsible to integrate & configure the supplied equipment/system as per finalized network topology at the time of Contract BOQ preparation and ensure integration as well as inter-working with the existing network/system of PGCB.

Any disagreement of clause 7.8 or sub-clause will be treated as “**Change of substance**”.

7.9 Guarantee Period including Maintenance Support (02 Years after PAC)

The contractor at his own cost, shall keep sufficient number of technical personnel to provide full maintenance support for OSP work at all sites under the purchase and provide all necessary maintenance support during the guarantee period. The contractor, at his own cost, shall engage at least one Operation and Maintenance (O&M) Engineers for Circuit configuration, 100G lamda commissioning and all system related activities which must be provided by the manufacturer’s own engineer(s). The Engineers shall be stationed in Dhaka to provide full maintenance support for all equipment and sites covered by this purchase up to the end of the guarantee Period. PGCB TEC/TSC may ask clarification regarding the capability/ experience of the manufacturer’s engineer(s) whether, they are capable to provide/have provided these kind of maintenance supports earlier. Any discrepancy(ies) found between submitted documents and clarification, the bidder will be treated as non-responsive.

The guarantee period shall commence from the date of successful commissioning of the first system (after issuance of PAC) into the network and will be valid for 02 (Two) years. The contractor shall provide all necessary spares during the guarantee period at his own cost.

General Features of Guarantee Period:

i) The Supplier shall provide guarantee for all the Equipment covered by this purchase. The guarantee shall be valid for 02 (Two) calendar year from the date of issuance of Provisional Acceptance Certificate (PAC).

ii) The Supplier must warrant that the goods supplied under the contract are new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

iii) The Supplier must further warrant that the all Goods supplied under this Contract shall have no defect, arising from design, materials, or workmanship or from any act or omission of the Supplier that may develop under normal use of the supplied Goods in the conditions prevailing in Purchaser's country.

iv) PGCB shall promptly notify the Supplier in writing within 30 (Thirty) days after the detection of such defect of any claims arising under this guarantee. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair/replace and return the defective goods or parts in guarantee thereof, without any cost to the Purchaser.

v) Supplier shall repair/replace and return all replaceable parts/cards which become faulty during the guarantee period. Supplier may use the buffer stock spares during the period but all faulty cards must be repaired / replaced and returned to PGCB before the end of guarantee period. PGCB shall apply and obtain all necessary permissions from necessary organizations i.e. CCIE (IP), BTRC (Clearance Certificate), Bangladesh Bank (NOC), Customs (Customs Clearance) etc. for all repair/replace and return services. Upon receipt of notice/claim, the Supplier shall repair/replace and return the defective goods or parts in guarantee thereof within 90 (Ninety) days of receipt of such claim and necessary permissions.

vi) If any non-replaceable Equipment or part of Equipment (Which fault cannot be removed using Spare cards) fails in this guarantee period, the Supplier shall repair and return this Equipment or it's concerned part free of cost to PGCB. PGCB shall apply and obtain all necessary permissions from necessary organizations i.e. CCIE (IP), BTRC (Clearance Certificate), Bangladesh Bank (NOC), Customs (Customs Clearance) etc. for all repair and return services.

vii) The Supplier Guarantee does not extend to the Equipment / Software, which has been modified, misused by the Customer or damaged by any abnormal conditions (water drain, water flow, fire etc.).

viii) The above Guarantee shall not apply to the Equipment which had been modified by PGCB without the written consent of the Supplier or handled otherwise than in accordance with Manufacturer's/Supplier's instructions or practices as applicable. The Supplier's liability with respect to the correction of any defect detected during the guarantee period shall cease if the Equipment has been repaired or replaced without Supplier's consent or if the Supplier is not informed in writing within 30 (Thirty) days after the detection of such defect.

ix) The Supplier shall guarantee the flow and availability of all spare parts and units without major design change for at least 8 (eight) years after the expiry of guarantee period and that, if there is any major design change or stoppage of production, the supplier shall arrange alternate solutions with the same price of original solution.

Any disagreement/ deviation of clause 7.9.1 and shall be treated as **"Change of Substance"**

7.10 Post Guarantee Maintenance Support (Year 3-5)

The contractor also needs to provide maintenance support up to 03 (Three) years after successful completion of Guarantee period as per contract. This support should be provided by the manufacturer's own Engineers. The contractor needs to quote essential spares for smooth operation and maintenance of the network. (at least 3% and maximum 5% of the contract value).

The Bidder, at his own cost, shall engage at least one Operation and Maintenance (O&M) Engineers and at least two other technical personnel. The Engineers shall be stationed in Dhaka to provide full maintenance support for all equipment and sites covered by this purchase up to the end of the post guarantee maintenance Period. This support service shall start from the date of cut-over of the first site covered by this purchase.

The support Engineer shall be fluent in English and shall have enough knowledge of the relevant system to effectively solve all O&M problems; the engineer must also have at least 3 (three) years of prior experience of providing such support in other countries. Details of the qualification criterion are mentioned in Section 3 of Volume 1. The bidder shall be responsible for all types of expenditure to be borne for the manpower, including all types of transportation.

The maintenance support service shall cover at least (but not limited to) the following services:

i) Regular visits to all relevant sites to check and monitor different aspects of the working systems.

ii) To remain stand-by to respond in the shortest possible time during any call by PGCB.

iii) Helping PGCB personnel to solve different software and hardware problems related to proper O&M of the equipment.

iv) Identify and remove different bugs in the system's operational software.

v) Helping PGCB personnel to properly maintain relevant databases related to O&M of the system.

vi) Preparation and submission of reports to PGCB about different aspects of O&M of the system.

vii) Giving on-the-job training to PGCB personnel about different aspects of O&M.

viii) Advising PGCB about different aspects of O&M, system dimensioning, expansion, etc.

ix) Transfer of technology to PGCB personnel

Any disagreement/deviation of clause 7.10 shall be treated as **"Change of Substance"**

7.11 On Demand Maintenance Assistance (Optional Item)

The contractor shall provide on demand maintenance assistance service in order to pro-

vide required maintenance work after initial 05 (five) years maintenance period and up to the life time of the system under the terms and conditions being fixed by two parties.

Any disagreement/deviation of clause 7.11 shall be treated as **"Change of Substance"**

7.12 Project Management

The Bidder shall provide together with its Bid, a complete description of its intended method for Project Management, including the proposed Management Organization, the Work Organization, the proposed Communication Organization between the Bidder and PGCB. The Bidder shall also provide a detail work plan with his bid.

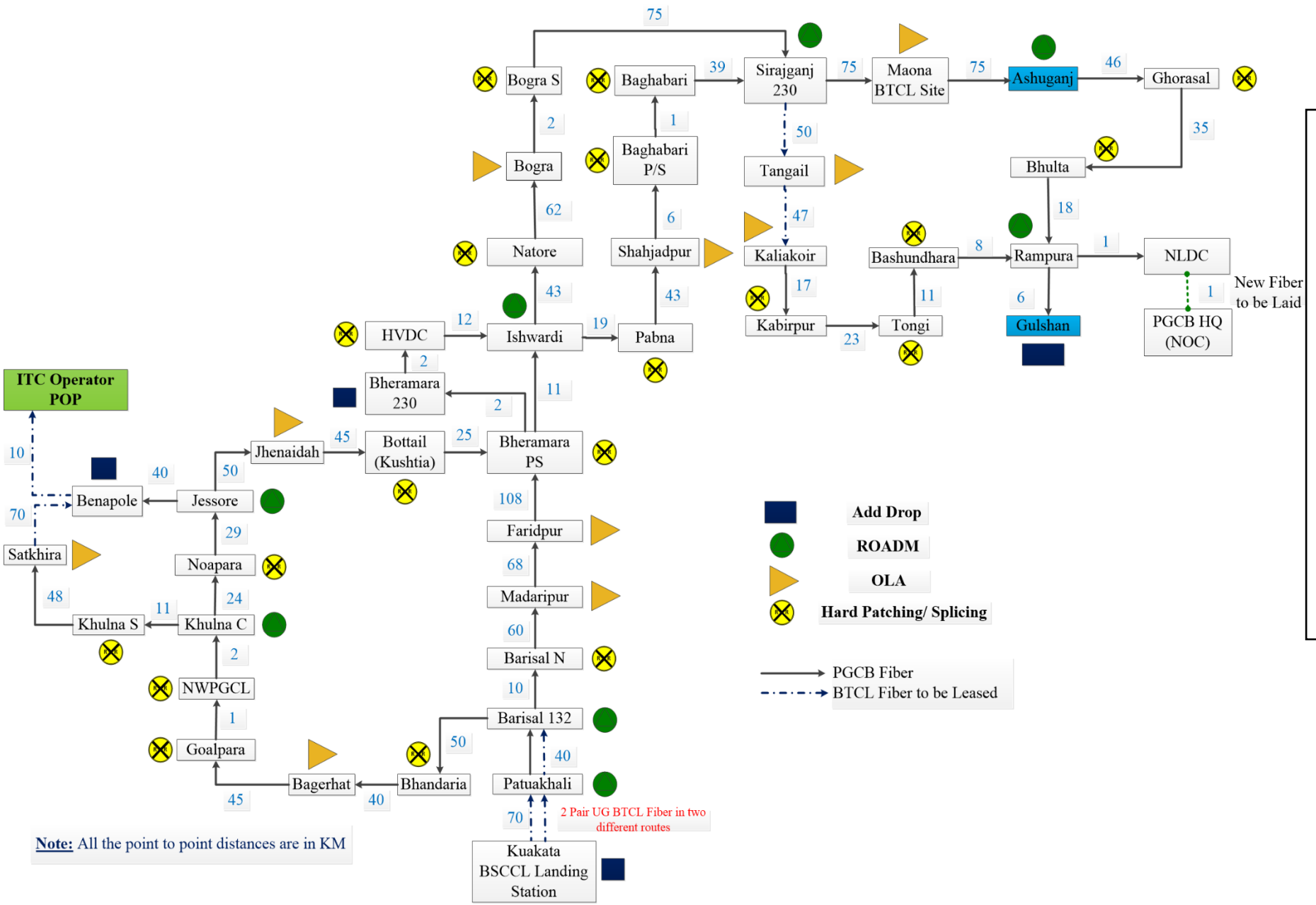
The Project Management Personnel must have adequate knowledge to make fluent conversation & technical discussion in Bangla as well as English. The CVs of the Project Manager and Project Engineers should be as per relevant clauses of ITT.

Absence of the required information in the bid as mentioned in clause 8.13 shall be treated as **"Change of substance".**

7.13 Transportation Service.

The bidder shall provide transportation service of 03 (Three) Pick-up VAN/ Micro Bus to the PGCB officials during all type of project works (Site Visit/ Testing and Commissioning Works) up to the completion of Project Period (Excluding Guarantee Period and Post Guarantee Maintenance Period).

Proposed Network Diagram for PGCB DWDM Deployment



Note: All the point to point distances are in KM

Annexure-1

Network Diagram

Annexure-2

Traffic Matrix (Present Demand)

No	Station A				Station B		
	Name	**100G Lamda**	**Client Interface**	**Line Interface**	**Line Interface**	**Client Interface**	**Name**
1	Kuakata	1	10X10G	1X100G	1X100G	10X10G	Dhaka
2	Kuakata	1	10X10G	1X100G	1X100G	10X10G	Bheramara 230
3	Benapole	1	10X10G	1X100G	1X100G	10X10G	Dhaka
Total=		3					

Annexure 3

Link wise dB (loss) Table

SI	Route		Distance (km)	Loss in (dB)	Remarks
1	Kuakata	Patuakhali	90	27	BTCL UG Fiber
2	Patuakhali	Barisal 132	50	25	
3	Patuakhali	Barisal 132	40.11	11.93	
4	Barisal 132	Barisal 230	9.89	2.49	
5	Barisal 230	Madaripur	52.52	13.97	
6	Madaripur	Faridpur	67.87	16.50	
7	Faridpur	Bheramara GK	108.9	34.00	
8	Bheramara GK	Bottail (Kustia)	24.34	6.99	
9	Bottail (Kustia)	Jhenaidah	44.51	11.73	
10	Jhenaidah	Jessore	49.64	12.50	
11	Jessore	Benapole	31.6	6.61	
12	Satkhira	Khulna South	48.52	16.00	
13	Khulna South	Khulna Central	9.97	3.99	
14	Khulna Central	NWPGCL	2.2	8.00	
15	NWPGCL	Goalpara	1	6.00	
16	Goalpara	Bagerhat	45.48	9.54	
17	Bagerhat	Bhandaria	40.55	10.10	
18	Bhandaria	Barisal 132	50.98	12.10	
19	Bheramara GK	Bheramara 230	0.25	0.07	
20	Bheramara 230	HVDC	3.78	1.50	
21	HVDC	Ishwardi	11.06	3.87	
22	Ishwardi	Bheramara GK	11.13	3.67	
23	Ishwardi	Pabna	18.89	5.67	
24	Ishwardi	Natore	43	10.32	
25	Natore	Bogra 132	63.72	15.93	
26	Bogra 132	Bogra 230	1.9	1.064	
27	Bogra 230	Sirajgonj 230	75.15	15.78	
28	Pabna	Shahjadpur	42.72	12.39	
29	Shahjadpur	Baghabari P/S	5.73	2.12	
30	Baghabari P/S	Baghbari	0.235	0.10	
31	Baghabari	Sirajgonj 230	39.7	9.53	
32	Sirajganj 230	Tangail	48	18	BTCL UG Fiber
33	Tangail	Kaliakoir	46.17	22	
34	Kaliakoir	Kabirpur	17	22	
35	Kabirpur	Tongi	22.99	6.5	
36	Tongi	Bashundhara	10.47	2.67	
37	Bashundhara	Rampura	7.20	2.20	
38	Rampura	Gulshan	-	-	
39	Sirajgonj 230	Ashuganj	149.07	36.03	Maona Drop
40	Ashuganj	Ghorasal	45.17	10.98	
41	Ghorashal	Bhulta	35.11	8.57	
42	Bhulta	Rampura	17.12	4.93	

Annexure-4

Traffic Matrix (Future Demand)

Consideration for Spare Parts

No	Station A				Station B		
	Name	100G Lamda	Client Interface	Line Interface	Line Interface	Client Interface	Name
1	Kuakata	1	1X100G	1X100G	1X100G	1X100G	Dhaka
2	Kuakata	1	10X10G	1X100G	1X100G	10X10G	Dhaka
3	Benapole	1	10X10G	1X100G	1X100G	10X10G	Dhaka
Total=		3					