SECTION V

4.1.6 PARTICULAR TECHNICAL SPECIFICATIONS

FOR

TELECOMMUNICATION SYSTEM

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4.1.6. Telecommunications

4.1.6.1. General requirements

The objective of the telecommunications system is to transmit and receive data, voice and Teleprotection signals. Telecommunication links based primarily on Fibre (OPGW and ADSS) multiplexers and on some cases Radio and PLC shall be established linking various equipment in substations to Regional Control Centres (RCCs). Necessary engineering required for transmitting data and speech signals to the Regional and National Control Centre(s) shall be included. The links shall consist of STM-1/4/16 SDH Terminal equipment(s), and shall be connected to existing KPLC network. KPLC has SDH network with the backbone mainly consisting of STM-1/4/16 network.

The telecommunication system to be provided shall be designed to transmit and receive data, voice, and Tele-protection signals where necessary.

Where the station is for Voltages above 66 kV the SAS/RTU and Telecommunications links shall be configured to have connection to both Regional and National Control Centres. These links shall include Tele-protection facilities with for four commands per line. For 33kV substations with a transformation capacity of less than 23MVA, the links shall be designed for connection to respective RCCs. .

These specifications describe the basic requirements for the Telecommunications various systems. Tenderers are requested to submit with their offers the detailed catalogues, brochures and technical drawings with the specific items on offer clearly marked for the products they intend to supply. Tenderers must indicate on the specifications sheets whether the equipment offered comply with each specified requirement.

The tender documents shall be accompanied by type test and routine test reports certified by the National Testing or the National standards Institute of the country of origin. At her discretion, all equipment shall be subjected to inspection by the clients Engineers or representative at the place of manufacture where all routine tests on randomly picked sample(s) shall be carried out in their presence. Test reports shall be completed for each equipment and made available to KPLC after the tests have been carried out. All the dimensions and capacities of the equipment to be supplied shall not be less than those required in these specifications. Deviations from the basic requirements, if any, shall be explained in detail in writing with the offer, with supporting data such as calculation sheets, etc. The Procuring entity reserves the right to reject the products, if such deviations shall be found critical to the use and operation of the products.

4.1.6.2. Fibre Optic Ground Wire (OPGW)

The overhead earth wire shall be Fibre Optic Ground Wire (OPGW) with a minimum of 48 strands. The Fibre optic earth wire supplied shall be suitable for installation on transmission line and shall be supplied complete with all necessary fittings and optical joint boxes. The earth wire fittings and optical joint boxes shall be type approved.

The manufacturer of the OPGW shall be responsible for the supervision of installation by the Contractor; to ensure that system reliability requirements are met.

The fibre optic earth wire shall comprise an optical sub-unit containing optical fibres over which shall be laid aluminium, aluminium alloy or aluminium coated steel strands. The clad steel wire incorporated in fibre optic earth wire shall comply with the requirements of IEC 61232. Shaped aluminium or aluminium alloy wire sections shall conform to the requirements of the appropriate IEC standard.

The optical sub-unit shall withstand the temperature rise associated with the specified lightning fault current flowing in the earth wire without damage. The fibre optic earth wire (OPGW) shall be manufactured in continuous lengths of not less than 4,000 m.

The overall system design of the fibre optic system shall meet the following minimum requirements:
Single failure or degradation in any optical fibre not more than one year averaged over five years;
Failures or degradations affecting more than one optical fibre, not more than one in ten years;
Increase in optical system transmission attenuation due to accumulated ageing and other effects at the end of five years and not more than 0.05 dB/km.
The Contractor shall ensure that the fibre optic cable are not strained or damaged either mechanically or optically during stringing and/ or jointing.
The cable shall be capped before shipment to prevent the ingress of water.

4.1.6.2.1. Optical Fibres

Optical fibres shall be 48 core single mode and shall conform to IEC 793-2-BI. The fibre coating material shall be mechanically strippable. The optical fibres shall be capable of being jointed by fusion technique.

There shall be no measurable long term or short-term optical attenuation change due to the temperature rise associated with a fault current flowing in an earth wire, or a lightning strike on the earth wire.

4.1.6.2.2. OPGW Fittings

The fibre optic earth wire shall be with approved conductor fittings. The application of these fittings shall not damage the earth wire or fibres, either mechanically or optically.
At each support, a bypass device shall be provided to guide the cable around the earth wire fittings associated with the support.

4.1.6.2.3. Optical Joint Boxes

Optical joint boxes shall be provided to protect the splice joint of optical fibres, either when individual lengths of the fibre optic OPGW, are jointed or between the fibre optic earth wire and the underground fibre optic cable.
The joint boxes shall consist of external steel or die cast aluminium housing providing protection to IEC 529 IP 44 and an internal die cast aluminium or high impact plastic ABS box to IEC 529 IP54
The external housing shall be designed so that the rainwater is directed away from the door and there shall be no water ingress when the door is opened.
The joint boxes shall be supplied complete with all fittings to secure and seal the cable in the gland plates or blank the unused spigots. The cable cleats to secure the fibre optic OPGW or underground cable shall be fitted inside the box. The cleats shall not have a detrimental effect on the performance of the optical fibres when tightened to the recommended torque.
The top and bottom of the joint box shall be vented and the vents provided with the vermin shields.

The box shall be supplied complete with internal splice cassettes to accommodate the required number of splices. The glands shall be fitted to accommodate either the fibre optic OPGW or underground fibre optic cable.

4.1.6.2.4. Fixing Clamps

A bolted clamping system shall be used to attach the OPGW to the inside of the support, without drilling or modifications to the support steel work. The attachment clamps shall be capable of being attached and detached from the support, without affecting the OPGW. Fixing clamps shall be made from a suitable grade of aluminium alloy complying with the requirements of BS 1490 and / or BS EN 1676. Bolts shall be made from mild steel grade S275JR to BS EN 10 025. Bolts and nuts shall be ISO Metric Black Hexagon to BS 4190 and shall unless otherwise specified be threaded ISO Metric Coarse Pitch to BS 3643: Part 2, Tolerance Class 7h/8g.

4.1.6.2.5. Non-Metallic Underground Fiber Optic Cable

Where required, the fibre optic cable shall be circular in cross section and shall be designed so that any cable strain is so directly imported on the optical fibres. The cable shall not include any metallic components to prevent high-induced voltages when used in switching or substation compounds.

4.1.6.2.6. Approach fiber optic Wire:

The ADSS/OPGW cable shall terminate at first structure after the bus bar at the substations. An underground fiber optic cable shall be run from this structure to the building. This approach cable shall be 48 core SM, armored, loose tube cable, with a dielectric central member. The cable shall be Kevlar yarn reinforced, steel tape armor and a UV resistant HDPE outer layer. It is for outdoor applications, in ducts, for direct burial or latched installations.

4.1.6.3. Fibre Optic Ground wire Specifications

The specification are based on IEC 60793 that lays down specification for an underground fibre optic cable and Fibre optic ground wire (OPGW)

4.1.6.3.1. References

The following documents were referred to during the preparation of this specification. In cases of conflict, the provisions of this specification shall take precedence.

Unless otherwise specified, the latest revision, edition and amendments shall apply.

Item	Description	Applicable Standard
1	Optical fibers (Generic & Product Specs.)	IEC 60793 part I & II
2	Cable Tests	IEEE 1138
3	Temperature Cycle Test	IEEE Std 563
4	Cable Self Damping	IEEE Std 4
5	Lightning Test	EIA/TIA-455-16A
6	Salt Spray Corrosion	MCIT 048-200 6508
7	Temperature Cycling/Ageing/Water Immersion	MCIT 048 200 6508

Note: All cables must conform to ITU G655

4.1.6.3.2. Service Conditions

The cables and accessories shall be suitable for continuous outdoor operation in tropical conditions in high altitude areas with the following atmospheric conditions.

Parameter	Max	Min
Ambient air temperature		
Outdoor	+40°C	-1°C
24 hour average maximum	+30°C	-1°C
Ambient temperature for cables in the ground	+40 °C	-1°C
Relative humidity	90%	
Average soil thermisivity	1.2Km/W	
Average depth of burial	1m	
Type of soil	Black cotton soil	
Height above sea level	1800 m	
EMC Class (IEC 61000)	Industrial environments	
Seismic coefficient	1.5	
Maximum solar radiation	1000W/m2	
Wind pressure on project area of conductors and cylindrical objects	400 N/m²	
Maximum wind pressure on steel members on 1.5 times projected area	820 N/m²	
Rainfall conditions		
Average	800-1700 mm/year	
Maximum	160mm in 24 hrs	
Annual mean isokeraunic level	Max 180 thunderstorm days	

4.1.6.3.3. Optical Fibre Cable application and Characteristics

Application

- The cable shall be for underground and overhead installation alongside the high Voltage cables.
- The cable shall be suitable for laying in cable ducts and in the ground in switching stations.
- The cable shall have the pre-requisite Mechanical Protection to prevent damage during installation and due to other Human activities such as excavation
- The cable shall be suitable for laying in areas next to roads with heavy traffic.
- The cable shall be resistant to aggressive chemical substances, corrosion and moisture.
- The cable shall offer good protection against rodents.
- The cable shall be specifically manufactured for underground installation and shall be all dielectric, hence unaffected by Electromagnetic induction from the high Voltage underground Cables. This shall be specifically stated in the Tender Offer.
- Permissible continuous operating temperature for all the fibres without degradation in characteristics shall be –20 °C to 70 °C.
- The shipping and storage temperature range of the cable shall be –50° C to 70° C

4.1.6.3.4. Material and Construction

i. The cable shall be an all dielectric, Single Mode, 48 Optical Fibres cable specifically manufactured for underground Installation.

ii. A written confirmation shall be obtained from the cable manufacturer giving an assurance that the cable so offered is suitable for underground installation alongside the 33kV Power cables and that it will give a reliable communication link suitable for Protection of the 33KV cable, Speech and Data Transmission.

iii. All material used under this Contract shall be new, of the highest quality and of the class most suitable for working under the conditions specified, shall withstand the variations of temperature and atmospheric condition arising under working conditions without distortion or deterioration or setting up of undue stresses on, or impairing the effectiveness of any part.

4.1.6.3.5. Geometrical and Optical Requirements

The fibre cables specified herein will fulfil the following geometrical specifications.

Parameter	**Requirement**
No. of fibres	48
Length	Various
Core diameter	9-10 microns
Cladding diameter	125+/- 2.0 microns
Mode field concentricity error	≤ 1.0 micron
Cladding non-circularity	≤ 2.0 %
Coating diameter	245 ± 8 microns
Mode field diameter	9 ± 1 Micron

OPTICAL

The single-mode 48cores fibre cables specified herein will fulfil the following optical specifications.

Parameter		**Requirement**
Attenuation coefficient	At 1310 nm.	≤ 0.35 dB/ Km.
	At 1550 nm.	≤ 0.22 dB/ Km.
Total chromatic dispersion	For 1280 nm ≤ Labda ≤ 1340 nm	≤ 2.9 ps/(nm*Km)
	At 1550 nm.	≤ 18 ps/(nm*Km)
Cable cut-off wavelength		Labda ≤ 1250 nm.

COLOUR CODE

The colour coding of fibres and tubes shall be in accordance with table below.

Number	Primary	Secondary
1	Natural	Red
2	Red	Natural
3	Blue	Natural
4	Yellow	Natural
5	Black	Natural
6	Violet	Blue
7	Brown	
8	Green	

etc. for the 48 fibres.

All colour codes must be able to distinguish each fibre strand from all other fibre in the same cable.

4.1.6.4. Specifications for ADSS Cable

Where required in the specific line scope of works the ADDSS cable shall meet following technical and general requirements. ADSS can only be installed in an existing 33kv lines, and in that case it shall be specified in the specific scope of works.

4.1.6.4.1. Design Principles:

The proposed Fibre cable shall be single mode, 48 core all-dielectric self-supporting cable (ADSS).

The cable shall be designed and manufactured in accordance with the following standards:

- Cable IEEE 1222
- Fiber IEC 60793, ITU-T G.65X series
- Colour code ANSI/EIA 359-A, IEC 60304

4.1.6.4.2. Route Survey:

Prior to design and installation, the contractor shall visit the route accompanied by KPLC staff to ascertain for themselves the requirements for the link. During this survey a pole count and a sketch for the cable installation shall be carried out. This sketch shall indicate the locations of splice boxes and the approximate distances between them. The poles shall also be assessed for their ability to support the ADSS cable. Any need for modification shall be determined at this stage.

Suitable drum lengths shall also be determined at this stage to reduce the number of joints preferably at section poles. KPLC shall assess the contractor's report and carry out modifications where it is felt necessary.

4.1.6.4.3. Installation:

The cable installation shall be aerial on existing power lines. Majority of these lines are on wooden structures and the ADSS cable shall be installed below the power line. The installation shall be done under live line conditions except in some instances where safe working clearance cannot be maintained.

It is not the intention of the employer to recommend any specific installation method but whichever method applied should be in accordance with the international standards, manufacturer's recommendation and within KPLC safety regulations.

4.1.6.4.4. Installation Materials & Fittings:

All bolts, nuts and clamps used during the construction shall confirm to IEEE standards that apply to testing and performance of Hardware for All-Dielectric Self Supporting cable (ADSS)
All fitting materials shall conform to the approve standards by IEEE1222. The bidder shall attach type test certificates from the certifying bodies

4.1.6.4.5. Splicing & Testing:

All joints shall be fusion spliced. The splice loss shall be equal to or less than **0.1db**. After all the terminations are done the cable shall be tested from ODF to ODF using the OTDR as well as power meter and the results tabulated.

4.1.6.4.6. Fittings & Spare Capacity

Unless otherwise specified in this specification, all requirements for individual components and completed cable shall be mainly in accordance with the following standard specifications.

1EE Std 1222, IEC 60794-4, IEC 60793-1, IEC 60793-2, IEC 60794-1, ITU-T G.650, ITU-T G.652, ITU-T G.655, EIA 492A, EIA 472A, EIA 598 or ANSI/EIA 359-A-1985, ISO 9001 and ISO 14001.
The Contractor shall include 10% spare cable capacity for future maintenance work on the link at agreed intervals.

4.1.6.5. Cable Accessories

Spliced joints/terminations
Spliced joints shall be suitable for the cable specified and shall contain all materials required to:

a) Mechanically connect the type and size of fibres specified
b) Optically connect the fibre specified
c) Provide the necessary di-electric strength within the joint;
d) provide an insulated outer housing;

The joints shall be designed and manufactured to ensure that all components and materials shall be suitable for use in the atmospheric conditions stated.

The complete components and materials shall be free from defects, which would be likely to cause them to be unsatisfactory in service.

The components and materials shall be manufactured to ensure high moisture sealing capacity, resistance to fungal and insect attack.

Specialized tools that are required during the jointing process shall be stated and the costs shall be quoted separately

All the fibres shall be terminated in the substation building using SC connectors in a patch panel properly mounted.

4.1.6.6. Factory Visit, Testing and Acceptance

Type and routine tests of the cable complete with accessories shall be carried out as per the requirement of the standards shown in the table below. Certified copies of such type test reports and certificates shall be attached to facilitate tender evaluation. Tenders without Type test Reports and certificates, certified by the National Testing or the National Standards Institute of the country of origin shall not be considered. Where available certificates from internationally recognized testing bodies can be included.

Test carried on cables		
	Cable Test Type	Applicable Standard
1	Water Ingress Test	IEEE 1138
2	Seepage of Flooding Compound	IEEE 1138
3	Short Circuit Test	IEEE 1138
4	Aeolian Vibration Test	IEEE 1138
5	Galloping test	IEEE 1138
6	Sheave Test	IEEE 1138
7	Crush Test	IEEE 1138
8	Impact Test	IEEE 1138
9	Creep Test	IEEE 1138
10	Fibre Strain Test	IEEE 1138
11	Strain Margin Test	IEEE 1138
12	Stress Strain Test	IEEE 1138
13	Cable Cut-Off Wavelength	IEEE 1138
14	Temperature Cycle Test	IEEE Std 563
15	Cable Self Damping	IEEE Std 4
16	Lightning Test	EIA/TIA-455-16A
17	Salt Spray Corrosion	MCIT 048-200 6508
18	Temperature Cycling/Ageing/Water Immersion	MCIT 048 200 6508
19	Tension Cycle Sustained Loading	MCIT 048 200 6508
20	Gas Tube Tightness Test	MCIT 048 200 6508
21	Twist Test	MCIT 048 200 6508
22	Bend Test	IEC 794
23	DC Resistance	
24	Generic fibre specifications	IEC 60793, IEC 60794
25	Ageing Test	EN187000

The cables shall be routine tested at the factory. Advance copies of factory test reports shall be submitted to KPLC before her representatives are dispatched for acceptance test exercise. Authority to deliver/ ship the cables to KPLC stores shall be given only after the report from this exercise show that they comply fully with the specification and referenced standards.
The manufacturer shall be required to demonstrate that the accessories mentioned earlier a re mechanically and optically fit for the cable during acceptance testing.

KPLC requires an advance notice of four (4) weeks before the commencement of Factory Tests & Inspection to enable engineers make the necessary arrangements to witness the tests.

Where KPLC engineers or her representatives require to visit and to inspect the cables manufacturing facility, all necessary help shall be provided. Such inspection shall not in any way prejudice the purchaser's rights and privileges throughout.

4.1.6.7. Manufacturer Eligibility

Only manufacturers who have the following qualifications shall be considered for the supply of the cable

a) At least 10 years' experience in manufacturing of underground optical cables laid adjacent to single core power cables (33kv and above).
b) Exported at least 500km of fiber cable cables per year to at least 3 countries with the same service conditions mentioned in clause 5.1 (e.g. counties in Africa, Australia etc)
c) Should have ISO 9001:2002
d) Should have ISO 14001

Manufacturers shall indicate the delivery time versus quantities of cables, monthly production capacity and experience in the production of this type of cables

Manufacturers shall submit the manufacturing process flow chart with explanations of each stage and quality control measures undertaken.

A detailed list and contact addresses of previous customers outside the country manufacture shall be submitted with the tender. KPLC reserves the right to contact customers if necessary

The manufacture shall provide current e-mail address, fax and telephone numbers and contact person at the National Standards and Testing Facility of the country where the cable is manufactured and tested. KPLC reserves the right to contact the body if necessary

i. Information

Detailed draft design and construction drawings showing the crossectional dimensions shall be submitted to KPLC before the manufacturing of the cables commence. KPLC undertake to submit their comments or approval for the drawings within three weeks of receiving the draft copies.

Sufficient relevant technical details and drawings shall be submitted for the purpose of Tender Evaluation. Tenders, which do not meet this requirement, will be considered non-responsive.

To facilitate comprehensive technical evaluation of the tenders, a clause-by-clause statement of compliance with the specification shall be submitted with relevant manufacturer's specification sheets, catalogues and brochure

ii. Packing

The cable shall be wound on wooden drums such as to prevent damage during transportation. The wooden drums shall be made from treated timber resistant to termite attack.

The following description shall be marked on one flange of the reel

a) Direction of rotation of the reel

b) Type of cable
c) Number of fibres and size
d) Length
e) Net weight and gross weight
f) Manufacturer's name
g) Year of manufacture

4.1.6.8. Optical Distribution Frames (ODF)

The optical fiber distribution frame (OFD) is installed for terminating optical fiber cables and patch cord. The distribution frame should include the metallic casing, adapter plate, splice tray, and other necessary materials for the termination of optical fiber cable. Therefore it should be designed properly for the fiber splicing and distribution. Separate storage shelf and distribution shelf can be offered if required. The OFD shall be of corrosion resistance and robust construction; and shall allow both top or bottom entry for access to the splice trays. Specific selection of the entry points shall be made at the time of installation. The OFD shall be installed on the international standard (ETSI 19") equipment rack or cabinet rack. The optical fiber distribution frames shall include all necessary parts to complete the joint. This will comprise all components to protect and store the spliced fiber; and provide sheath continuity. The distribution frame shall be designed with enough spare capacity for fiber splices. The distribution frame shall be made from fabricated mild steel not less than 1.2mm thick or equivalent and painted in good condition. The design of the fiber distribution frame shall allow minor deviations from the escribed installation procedures without any harm to the fibres and the long-term performance of the installation. The shelf and the connection between shelves shall be designed to maintain minimum bending radius of 30mm, the connectors to be used shall be subject to approval by the Project Manager.

Assignment between station fibre cable and OLTE's shall be made by using patch cords between the termination box and the optic distribution frame. Capacity of the optic distribution frame shall allow free assignment between each individual fibre of the station fibre optic cables and the relevant optical I/O ports of the OLTE's.

The optic distribution frame shall be equipped with low loss optical connectors (< 0.25 dB including the loss in the bulk head, loss in the connector splice & the loss in the pig tail) of the screw-on type. Auxiliary connectors shall be provided to facilitate testing and maintenance of the fibres/equipment. All spare fibres shall be properly terminated and spliced on connectors of the same type within the frame

4.1.6.9. Fibre Terminal Equipment

The terminal equipment shall be the type SDH STM-1/4/16 optical terminal equipment and shall be supplied from 48 VDC source.

SDH (STM-1/4/16) multiplexer shall be installed in racks that are EMC compatible and suitable to work in HV system environments.

The multiplexer shall be based on the SDH technology, working on the basic transmission Bit Rate of 155.520 Mbit/s (STM-1). It shall be in accordance with the latest

ITU-T SDH recommendations such as: G.703, G.704, G774, G.783, G.784, G.785, G.811, G.812, G.813, G.823, G.825, G.826 and M.3010.

The equipment shall be able to perform both, multiplexing and line terminating functions. The SDH Equipment (Terminal Equipment, Add/Drop Multiplex, Synchronous Digital Cross-Connect) to be offered shall meet the following requirements:

a) It shall have at least all the functions outlined in ITU-T G.783.
b) The PDH electrical tributary interfaces to the SDH equipment shall conform to ITU-T G.703.
c) The SDH electrical and optical interfaces shall conform to ITU-T G.703 and G.957.
d) The cross-connect offered shall be capable of providing non-blocking connection between virtual containers.
e) The Optical Power to be offered shall be such that under normal operating condition, the BER of the system at the receiver is better than 1x10-10. Error performance versus the receive signal shall be verified during the factory acceptance tests.

The multiplex structure shall conform to ITU-T G.707. Details of the Multiplex structure for the offered equipment including the usage of the overhead bits shall be detailed with the offer.
The synchronous optical interface protection shall be achieved by having 1+1 protection. The laser shall automatically cut-off when the link is disturbed. Redundant cross connect, where failure on either one shall not cause link outage, and path protection on the traffic interface and the 2 Mbit/s levels shall also be provided.

Timing and synchronization shall conform to ITU-T G. 783, G.811, G.812 and G.813. Timing references, number of timing references available, switching time to a different timing reference, type and level of clocks shall be stated in the offer.
The equipment shall automatically switch to another clock if the reference timing is lost and automatically revert back upon restoration. The accuracy of the internal clock as well as the details of the clock signal distribution shall also be stated in the offer.

The equipment shall be capable of diverting timing references between the STM-1, 2 Mbit/s and a G.703 tributary interfaces.
The SDH equipment shall be wired for the full STM-1 capacity, however equipped under the scope of this specification to receive at least four (4) PCM tributaries as specified below. However, if higher PDH signals other than the 2 Mbit/s are required to be routed through, the same shall be possible just by adding the respective interface cards and no extra wiring needed. It shall have 2 Mbit/s outputs where it can directly be connected to digital telephone exchanges or teleprotection equipment.

The jitter and wander tolerance for PDH and SDH interfaces shall conform to ITU-T G.823 and G.825. Jitter and wander characteristics of SDH multiplex and line equipment shall conform to ITU-T G.783.

The Contractor shall submit the details of the power budget calculations stating the following (based on 0.25 dB/km optical fibre attenuation at 1550 nm):

a) Transmitter Power
b) Minimum receive Signal @ BER $1x10^{-10}$
c) Connector Loss
d) Repair Splice Loss

e) Power Penalty (Chromatic dispersion and LD reflection Loss)
f) Maintenance Margin (> 2dB)
g) Other Loss
h) System Margin

The SDH equipment to be offered shall provide the followings:

a) A data communication channel to the Telecommunication Management Network, in accordance with ITU-T G.773 for the purpose of integration of the new equipment into the Telecommunication Network Management System.
b) A Craft interface in accordance with ITU-T G.773 to allow a local terminal to access the network element.
c) An engineer order–wire which shall have conference and selective calling features.
d) Performance monitoring in accordance with ITU-T G.784 and G.826.
e) Optical safety as per ITU-T G.783.

The alarm functions shall include but not limited to:

a) Alarms classified as critical, major, minor, and information.
b) Indications of loss of incoming signal.
c) Visual and audible indication of alarms.
d) Test function of alarm indicators to ensure workability of alarm indicators.
e) Alarm functions shall be detailed by the Contractor, e.g. if implemented in Telecommunication Network Management System:-

Offered equipment shall have sufficient capacity for speech, Ethernet data, SCADA data etc. and capable of extension to higher capacity by adding relevant modules.

4.1.6.10. Spare Parts, Tools and Test Equipment

Spares for Telecommunications if required in the mandatory spare schedule, shall be one module for each type of the modules supplied. Specialised tests tools and equipment for testing, configuration and maintenance of equipment, shall be supplied. This shall include data tester and optical test tools.

The test equipment and other special tools proposed shall be of the same type as used by the contractor for erection and commissioning. The test equipment shall be new and shall not however be available to the contractor during erection and commissioning. All licences required for commissioning of equipment shall be included. An OTDR (MTS 8000) or its Equivalent, and 1000mts of cable and Spice kit shall be supplied if required in the schedule for mandatory. The Contractor shall furnish a list of recommended spare parts for the OLTEs.

4.1.6.11. Documentation:

i. The Contractor shall provide all necessary drawings, design specifications, design details, operation and maintenance manuals. All manuals and As-Built-Drawings documents shall be supplied in three hard copies and a softcopy in PDF.
ii. Functional Design Specification (FDS)
iii. Test Specification for Factory Acceptance Test (FAT)
iv. Operator's Manual
v. Product Manuals

4.1.6.12. Training:

The Contractor shall provide 1 week training for four KPLC staff at the supplier's manufacturing premises on each Telecommunication type of equipment supplied and on site during installation works. All training costs shall be borne by Contractor including travel to manufacturers place. Accommodation which shall be borne by KPLC. The scope of each service shall be given. The training content shall be subject to approval of the project Manager.

4.1.6.13. Testing

The formal stages of testing to be performed fall into the following three categories:

- Type Tests Equipment shall pass these tests in order to be accepted for use under this Contract
- Factory Acceptance Tests (FAT) Systems shall pass these tests before they may be shipped to site. The employer shall witness FATs unless he waives this in writing. FAT preparation costs shall be borne by contractor except transport and accommodation. FAT shall be carried by two KPLC staff for 5 days..
- Site Acceptance Tests (SAT) Systems shall pass these tests before they may be put into operation and before they are Taken Over

4.1.6.14. System Acceptance

The System will be accepted by KPLC if both:

- The System and all items of equipment have successfully completed all the specified tests
- All failures, problems and reservations noted during the tests have been corrected to the satisfaction of KPLC.
- If either of these conditions has not been complied with, then the necessary corrective action shall be agreed between the Contractor and KPLC**.**