

**SECTION VI**  
**TECHNICAL SCHEDULES**

TECHNICAL SCHEDULES .....	1
PREAMBLE.....	1
<b>TECHNICAL SCHEDULES SUBSTATIONS.....</b>	<b>2</b>
SCHEDULE VI-1a TECHNICAL GUARANTEES, OUTDOOR SWITCHGEAR .....	2
SCHEDULE VI-2a TECHNICAL GUARANTEES, INDOOR MV INDOOR SWITCHGEAR .	<i>Error! Bookmark not defined.</i>
SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR .....	<i>Error! Bookmark not defined.</i>
SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR .....	<i>Error! Bookmark not defined.</i>
SCHEDULE VI 3a TECHNICAL GUARANTEES, CONTROL SYSTEM .....	10
SCHEDULE VI 3b INFORMATIVE DATA, CONTROL SYSTEM .....	11
SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.....	12
SCHEDULE VI 4b INFORMATIVE DATA, PROTECTION ETC. ....	18
SCHEDULE VI 5b INFORMATIVE DATA, CABLES .....	20
SCHEDULE VI 5b INFORMATIVE DATA, CABLES .....	21
SCHEDULE VI 6a TECHNICAL GUARANTEES, EARTHING.....	22
SCHEDULE VI 6b INFORMATIVE DATA, EARTHING.....	23
<b>TECHNICAL SCHEDULES TRANSFORMERS .....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
SCHEDULE VI 7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS.....	<i>Error! Bookmark not defined.</i>
SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMERS .....	<i>Error! Bookmark not defined.</i>
SCHEDULE VI 8a - TECHNICAL GUARANTEES, DISTRIBUTION TRANSFORMERS .....	<i>Error! Bookmark not defined.</i>
SCHEDULE VI-8b - INFORMATIVE DATA, DISTRIBUTION TRANSFORMER .....	<i>Error! Bookmark not defined.</i>
<b>SCHEDULE VI-9A- INFORMATIVE DATA TELECOMMUNICATION SYSTEM....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
SCHEDULE VI-9B- INFORMATIVE DATA TELECOMMUNICATION SYSTEM .....	25

## **TECHNICAL SCHEDULES**

### **PREAMBLE**

- 1.1 The Technical Schedules shall be filled in and completed by the Bidder, and submitted with the Bid. The type test reports and the relevant manufacturer's technical documents shall be provided for reference.
- 1.2 All documentation necessary to evaluate whether the equipment offered is in accordance with this Specification shall be submitted with the Bid.
- 1.3 All data entered in the Schedules of Technical Guarantees are guaranteed values by the Bidder and cannot be departed from whatsoever.
- 1.4 All data entered in the Schedules of Informative. Data are also guaranteed values by the Bidder. These data may only be altered following the Project Manager's written consent.

## TECHNICAL SCHEDULES SUBSTATIONS

### SCHEDULE VI-1a TECHNICAL GUARANTEES, OUTDOOR SWITCHGEAR

Sheet 1 of 4

OUTDOOR SWITCHGEAR			33kV	132kv	Reference Doc
Item	Particulars	Unit	Guar. Fig	Guar. Fig	
a.2	<b>Circuit Breakers</b> (Type _____)				
	Breaking Medium	SF <sub>6</sub> /Vacuum			
	Manufacturer				
	- Rated voltage	kV			
	- Maximum service voltage	kV			
	- Rated frequency	Hz			
	- Rated continuous current	A			
	- One minute power frequency withstand voltage, dry and wet				
	- to earth	kV rms			
	- across open breaker pole	kV rms			
	- Impulse withstand voltage 1.2/50 ms				
	- to earth	kV peak			
	- across open breaker				
	- Breaking capacity at rated voltage				
	- symmetrical	kA rms			
	- asymmetrical	kA rms			
	- Making capacity	kA peak			
	- Breaking capacity of capacitive current	A			

## SCHEDULE VI-1a TECHNICAL GUARANTEES, OUTDOOR SWITCHGEAR

Sheet 2 of 4

OUTDOOR SWITCHGEAR			33 kV	132kv	
Item	Particulars	Unit	Guar. Fig		Reference Doc
	<b>Circuit breakers continued</b> <ul style="list-style-type: none"> <li>- Overvoltage factor for disconnection of unloaded transformers (without voltage limitation by lightning arresters)</li> <li>- Rated inductive current switching capacity</li> <li>- Permissible 1 second short-time current</li> <li>- Dynamic short-time current</li> <li>- Opening time, interval of time between the instant of application of tripping impulse to the instant when the main contacts have separated in all poles</li> <li>- Make time, interval of time between the initiation of closing operation and the instant when the current begins to flow in the main circuit</li> <li>- Total break time, interval of time between the instant of application of tripping impulse to the instant of final arc extinction in all poles <ul style="list-style-type: none"> <li>- at 100% breaking capacity</li> <li>- under phase opposition</li> </ul> </li> <li>- Rate of rise of recovery voltage (RRRV) at 100% short circuit current <ul style="list-style-type: none"> <li>- 3-phase</li> <li>- 1-phase</li> </ul> </li> <li>- RRRV out of phase duty</li> <li>- Minimum temperature rise at rated current of main contact</li> </ul>	 A kA rms kA peak  m.sec.  m.sec.   m.sec. m.sec.  kV/msec kV/msec  °C			
a.3	<b>Earthing Switches</b> <ul style="list-style-type: none"> <li>- Rated short-time current 1 sec.</li> <li>- Rated dynamic short-circuit current</li> <li>- Making Capacity</li> </ul>	 kA rms			

## SCHEDULE VI-1a TECHNICAL GUARANTEES, OUTDOOR SWITCHGEAR

Sheet 3 of 4

OUTDOOR SWITCHGEAR			33 kV	132kv	
Item	Particulars	Unit	Guar. Fig	Guar. Fig	Reference Doc
a.4	<p><b>Current Transformers</b></p> <p>Manufacturer</p> <ul style="list-style-type: none"> <li>- Rated voltage</li> <li>- Maximum service voltage</li> <li>- Rated frequency</li> <li>- One-minute power frequency test voltage of               <ul style="list-style-type: none"> <li>- primary winding</li> <li>- secondary winding</li> </ul> </li> <li>- Lightning impulse withstand voltage</li> <li>- Rated primary currents</li> <li>- Rated secondary current</li> <li>- Short-time thermal rating               <ul style="list-style-type: none"> <li>- 1 second</li> </ul> </li> <li>- Short-time dynamic rating</li> <li>- Burden and accuracy class of               <ul style="list-style-type: none"> <li>- measuring core</li> <li>- protection core</li> </ul> </li> <li>- Instrument security factor of the measuring core</li> <li>- Accuracy limit factor of the               <ul style="list-style-type: none"> <li>- protection core</li> </ul> </li> </ul>	<p>kV</p> <p>kV</p> <p>Hz</p> <p>kV rms</p> <p>kV rms</p> <p>kV peak</p> <p>A</p> <p>A</p> <p>kA rms</p> <p>kA peak</p>			
a.5	<p><b>Voltage Transformers, Type _____</b></p> <p>Manufacturer</p> <ul style="list-style-type: none"> <li>- Rated voltage</li> <li>- Maximum service voltage</li> <li>- One-minute power frequency test voltage               <ul style="list-style-type: none"> <li>- primary winding</li> <li>- secondary winding</li> </ul> </li> <li>- Lightning impulse withstand voltage</li> <li>- Burden and accuracy class of               <ul style="list-style-type: none"> <li>a. measuring winding</li> <li>   protection winding</li> </ul> </li> <li>- Ratio</li> </ul>	<p>kV</p> <p>kV rms</p> <p>kV rms</p> <p>kV rms</p> <p>kV peak</p> <p>kV</p>			
a.6	<p><b>Country of Manufacture</b></p> <ul style="list-style-type: none"> <li>- Cubicles</li> <li>- Circuit breakers</li> <li>- Current transformers</li> <li>- Voltage transformers</li> </ul>				

--	--	--	--	--	--	--	--

## SCHEDULE VI-1b INFORMATIVE DATA OUTDOOR SWITCHGEAR

Sheet 1 of 3

Item	Particulars	Unit	33 kV	
b.2	<b>Circuit Breakers</b>			
	- Reference standard			
	- Type of breaker and designation			
	- Voltage drop across main contacts at rated current	mV		
	- Type of main contact	mm		
	- Type of arch control device	m/s		
	- Method of closing			
	- Method of tripping			
	- Max. percentage of recovery voltage across any break	%		
	- Minimum clearance between live parts and earth, in SF6 or vacuum	mm		
	- Min distances between phases			

## SCHEDULE VI-1bINFORMATIVE DATA, OUTDOOR SWITCHGEAR

Sheet 2 of 3

Item	Particulars	Unit	33 kV	Reference Doc
	- Number of opening operations permissible before inspection and maintenance of contacts, gas treatment etc.			
	- at rated current			
	- at maximum short circuit current			
	For SF <sub>6</sub> breakers			
	- Normal gas density for SF <sub>6</sub> circuit breaker (represented by gas pressure)			
	- at 20°C	Bar		
	- at 40°C	Bar		
	- Minimum gas density for safe operation			
	- at 20°C	Bar		
	- at 40°C	Bar		
	- Quantity of gas required per 3-pole breaker	kg		
	- Operating pressure of relief device	Bar		
	- Method of monitoring pressure and temperature compensation			
	- Max. permissible dew point temp.	°C		
	- Max. permissible acidity level			
	- Max. permissible leak rate	%/year		
	For vacuum breakers			
	- Vacuum in break chamber	torr		
	- Max. permissible leak rate	%		
	For all breakers			
	- Control voltage	V DC		
	- Type of operating device			
	- Motor voltage			
	- AC of DC			
	- Max. permissible service voltage	V		
	- Min. service voltage	V		
	- Starting current of motor			
	- Power consumption of motor			
	- When starting	W		
	- When running	W		
	- Power consumption of			
	- Closing coil	W		
	- Trip coil	W		
	- Heater	W		

## SCHEDULE VI-1bINFORMATIVE DATA, OUTDOOR SWITCHGEAR

Sheet 3 of 3

Item	Particulars	Unit	33 kV	Reference Doc
	<ul style="list-style-type: none"> <li>- Auxiliary switch</li> <li>- Rupturing current at 110 V DC</li> <li>- Number of free NO contacts</li> <li>- Number of free NC contacts</li> <li>- Test voltage 50Hz, 1 min.</li> </ul> <p>Manufacturer's of:</p> <ul style="list-style-type: none"> <li>- Support insulators</li> <li>- Breaker insulators</li> <li>- Operating mechanism</li> </ul> <p><b>NOTE</b></p> <ul style="list-style-type: none"> <li>- In addition to the characteristics listed above, the following information shall be given for all switchgear:</li> <li>- Layout and overall dimensions drawings</li> <li>- descriptions</li> </ul>	<p>A</p> <p>V</p>		
b.3	<p><b>Earthing Switches</b></p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type of isolating switch</li> <li>- Min. creepage distance (live parts to earth)</li> <li>- Min. isolating distance (clearance between open contacts)</li> <li>- Material of contact surface</li> <li>- Total contact pressure</li> <li>- Type of operating device</li> <li>- weight of earthing switch</li> </ul>	<p>mm</p> <p>mm</p>		
b.4	<p><b>Current Transformers</b></p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type designation</li> <li>- Overall dimensions</li> <li>- Total weight of one current transformer</li> <li>- Type of insulation</li> </ul>	<p>kg</p>		
b.5	<p><b>Voltage transformers</b></p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type designation</li> <li>- Overall dimensions</li> <li>- Total weight of one current transformer</li> <li>- Type of insulation</li> <li>- Type of insulation</li> </ul>	<p>kg</p>		

**SCHEDULE VI-2a TECHNICAL GUARANTEES, MV INDOOR SWITCHGEAR**

Sheet 4 of 6

MV INDOOR SWITCHGEAR			33 kV		
Item	Particulars	Unit	Guar. Fig	Guar. Fig.	Reference Doc
a.1	<p><b>Cubicles</b></p> <p>Manufacturer</p> <ul style="list-style-type: none"> <li>- Rated Voltage</li> <li>- Maximum service voltage</li> <li>- Rated frequency</li> <li>- Rated continuous busbar current</li> <li>- One minute power frequency withstand voltage, dry and wet               <ul style="list-style-type: none"> <li>- to earth</li> </ul> </li> <li>- Impulse withstand voltage 1.2/50 ms               <ul style="list-style-type: none"> <li>- to earth</li> </ul> </li> <li>- Permissible 1 second short-time current</li> <li>- Dynamic short-time current</li> </ul> <p>Arch tested in accordance with IEC 60280 amendment 2</p>	<p>kV</p> <p>kV</p> <p>Hz</p> <p>A</p> <p>kV rms</p> <p>kV peak</p> <p>kA rms</p> <p>kA peak</p> <p>Yes/no</p>			
a.6	<p><b>Country of Manufacture</b></p> <ul style="list-style-type: none"> <li>- Cubicles</li> </ul>				



## SCHEDULE VI 3b INFORMATIVE DATA, CONTROL SYSTEM

Sheet 1 of 1

SUBSTATION CONTROL SYSTEM (SCS)			
Item	Description	Unit	Data
b.1	<p><b>General System Considerations</b></p> <ul style="list-style-type: none"> <li>- Software               <ul style="list-style-type: none"> <li>- Package</li> <li>- Which RTU communication protocols are supported</li> </ul> </li> <li>- Real-time database               <ul style="list-style-type: none"> <li>- Package</li> <li>- Is an SQL interface supported</li> </ul> </li> <li>- Database Management Tool               <ul style="list-style-type: none"> <li>- Package</li> <li>- Is an SQL interface supported?</li> </ul> </li> <li>- Man-machine Interface               <ul style="list-style-type: none"> <li>- Package</li> <li>- State type of man-machine interface software</li> </ul> </li> </ul>		
b.2	<p><b>Operator Workstation</b></p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type designation</li> <li>- Weight</li> <li>- Mounting arrangement</li> </ul> <p>VDU</p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type designation</li> <li>- Diagonal screen size</li> <li>- Usable display area</li> <li>- Weight</li> <li>- Mounting arrangement</li> </ul> <p>Alphanumeric Keyboard</p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type designation</li> <li>- Mounting arrangement</li> </ul>	<p>kg</p> <p>mm</p> <p>max. mm</p> <p>kg</p>	

## SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.

Sheet 1 of 3

CONTROL, PROTECTION, METERING, SIGNALLING				
Item	Particulars	Unit	Guar. Fig	Reference Doc
a.1	<p><b>Indicating Instruments</b></p> <ul style="list-style-type: none"> <li>- To be filled in for each AC and DC Ampere meter and Voltmeter and for each Wattmeter, VAr-meter, Frequency-meter and other indicating instruments:</li> <li>- Instrument for: (A, V (AC), V (DC), W, etc.) <ul style="list-style-type: none"> <li>- Error</li> <li>- Max. admissible current</li> <li>- Max. admissible voltage</li> </ul> </li> </ul>	     % %. $I_N$ %. $I_N$		
a.2	<p><b>Meters</b></p> <ul style="list-style-type: none"> <li>- To be filled in for each meter</li> <li>- Meter for (MWh, MVArh): <ul style="list-style-type: none"> <li>- Error with 5% load</li> <li>- Error with 10% load</li> <li>- Error with 20% load</li> <li>- Error with 100% load</li> <li>- Max. admissible current</li> </ul> </li> </ul>	     % % % % %. $I_N$		
a.3	<p><b>Metering Converters (Transducers)</b></p> <ul style="list-style-type: none"> <li>- Converter for (MW, MVA, A, etc): <ul style="list-style-type: none"> <li>- Error</li> <li>- Linearity</li> <li>- Max. admissible current for 0.5 seconds</li> <li>- Max. admissible current continuously</li> <li>- Max. admissible voltage for 0.5 seconds</li> <li>- Max. admissible voltage continuously</li> </ul> </li> </ul>	     % % %. $I_N$ %. $I_N$ %. $I_N$ %. $I_N$		

## SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.

Sheet 2 of 3

## CONTROL, PROTECTION, METERING, SIGNALLING

Item	Particulars	Unit	Guar. Fig	Reference Doc
a.4	<p><b>Protection Relays</b></p> <p>- To be <b>copied</b> and filled in for each type of relay as applicable</p> <p>Relay for _____:</p> <p>- Accuracy of the adjustable tripping time</p> <p>- Min. possible tripping time</p> <p>- Drop out ratio</p> <p>- Directional sensitivity (dist. relay only)</p> <p>- Max. admissible current during 0.5 sec.</p> <p>- Max. admissible current continuously</p> <p>- Relation between tripping coil current and holding coil current (diff. relay only)</p> <p>- Limit value of the adjustable tripping current (O.C.R.)</p> <p>- Limit value of the instantaneous tripping current (O.C.R.)</p> <p>- Limit value of the adjustable tripping voltage (O.V.R.)</p> <p>- Limit value of the instantaneous tripping voltage (O.V.R.)</p> <p><u>Distance Protection</u></p> <p>Shall incorporate the following features:</p> <ul style="list-style-type: none"> <li>• Ratings: AC Inputs: 110V, 1Amp (three phase).</li> <li>• Power Supply Voltage: 110VDC. (Universal power supply of 30-300VDC is preferred).</li> <li>• The relays shall be of Numeric design.</li> <li>• Impedance criteria.</li> <li>• Three zones phase –phase Protection.</li> <li>• Three zones phase –earth Protection</li> <li>• Additional Zone 4 Protection</li> <li>• Automatic Switch on to fault.</li> <li>• Independent settings for each zone.</li> <li>• Distance to fault measurement.</li> <li>• Display: On operation, the relay should display the faulted phase(s), time and zone of operation and distance to fault.</li> <li>• IDMT Three Phase/Over current &amp; Earth fault Protection.</li> <li>• Fuse failure supervision.</li> <li>• Auto- reclose logic 1 and/or 3 phases.</li> <li>• Three pole tripping logic.</li> <li>• Disturbance and event records including software for disturbance analysis.</li> <li>• Fault record should be incorporated.</li> <li>• At least six (6) Binary inputs.</li> <li>• Mho/Quadrilateral characteristics.</li> </ul>	<p>sec.</p> <p>ms</p> <p>%</p> <p>%.<math>I_N</math></p> <p>%.<math>I_N</math></p> <p>%</p> <p>%.<math>I_N</math></p> <p>%.<math>I_N</math></p> <p>%.<math>I_N</math></p> <p>%.<math>I_N</math></p> <p>Shall incorporate all the features as listed</p>		

	<ul style="list-style-type: none"> <li>• Stability against Switching inrush currents and Reverse faults.</li> <li>• Clear faulted phase indication.</li> <li>• Clear fault identification even for boundary conditions.</li> <li>• Software necessary for all above functions shall be provided.</li> <li>• Three sets of Installation, Commissioning and maintenance manuals shall be provided.</li> </ul> <p><u>Three phase numeric directional over current and earth fault relay</u></p> <p>Shall incorporate the following features:</p> <ul style="list-style-type: none"> <li>• Relay must be of Numerical design.</li> <li>• Current setting range for over current relay 0.5In-2.4In</li> <li>• Current setting range for earth fault relay 0.05In-0.8In</li> <li>• Quadrature connection for polarising voltage (Vn=110)</li> <li>• Applicable on the LV side of a Dyn1 transformer</li> <li>• High set Element, with a setting range of 1-32In</li> <li>• The phase and earth directional elements should be individually selectable.</li> <li>• I.D.M.T characteristics according to BS 142 or IEC 60255 and Definite time characteristic</li> <li>• The normal operating boundary shall be +/-90 degrees from relay characteristic angle Relay sensitivity should be 1% of rated value of current and current polarising voltage at an angle equal to the relay characteristic angle.</li> <li>• Time setting multiplier 0.05 - 1.0</li> <li>• Broken conductor protection feature</li> <li>• Negative sequence Protection Feature</li> <li>• Highset Element for both over current and earth fault Protection, with a setting range of 1-30In.</li> <li>• Thermal Protection.</li> <li>• Dedicated Breaker Fail Protection.</li> <li>• Circuit Breaker Maintenance</li> <li>• Incorporate Fault records, Event Records and disturbance records.</li> <li>• Configurable output relays with ability to output starting elements to control Tripping of other upstream Protection relays.</li> <li>• Must provide all technical and operations manuals and configurations and settings software.</li> </ul>	<p>Shall incorporate all the features as listed</p>		
--	---	---	--	--



	<p><u>Three phase numeric IDMTL over current and earth fault relay</u></p> <p>Should incorporate the following Features;</p> <ul style="list-style-type: none"> <li>• Relay must be of Numerical Type</li> <li>• Current setting range for over current relay 0.5In-2.4In</li> <li>• Current setting range for earth fault relay 0.05In-0.8In</li> <li>• I.D.M.T characteristics according to BS142 or IEC 60255 i.e. SI,VI,EI,LLTI, including definite time for the high-set Elements.</li> <li>• Time setting multiplier 0.05 - 1.0</li> <li>• Broken conductor protection feature</li> <li>• Negative sequence Protection Feature</li> <li>• Highset Element for both over current and earth fault</li> <li>• Protection, with a setting range of 1-30In.</li> <li>• Thermal Protection</li> <li>• Dedicated Breaker Fail Protection.</li> <li>• Circuit Breaker Maintenance</li> <li>• Fault records, Event Records and disturbance records.</li> <li>• Configurable output relays with ability to output starting elements to control Tripping of other upstream Protection relays.</li> <li>• Drop off /pickup ratio &gt;90%</li> <li>• Low transient overreach &lt; 10%</li> </ul> <p><u>Restricted Earth fault relay</u></p> <ul style="list-style-type: none"> <li>• Relay must be of Numerical type</li> <li>• Relay should reject harmonics produced by C.T saturation</li> <li>• The offer should include the associated stabilising resistor and voltage dependent resistor (metrosil)</li> <li>• Current setting range 0.05-0.8In</li> <li>• Operating time &lt; 25ms at 5 times the setting</li> </ul>	<p>Shall incorporate all the features as listed</p> <p>Shall incorporate all the features as listed</p>		
--	---	---	--	--

**SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.****Sheet 3 of 3**

## CONTROL, PROTECTION, METERING, SIGNALLING

Item	Particulars	Unit	Guar. Fig	Reference Doc
a.5	<p><b>Auxiliary Circuit Breakers</b></p> <ul style="list-style-type: none"> <li>- To be filled in for each type of AC and DC breaker:</li> <li>- Min. operating voltage</li> <li>- Max. operating voltage</li> <li>- Drop out voltage</li> <li>- Service life (min. number of contact operation)</li> </ul>	<p><math>\%.U_N</math></p> <p><math>\%.U_N</math></p> <p>V</p>		
a.6	<p><b>Manufacturer's Name</b></p> <ul style="list-style-type: none"> <li>- Control room boards</li> <li>- Local relay boards</li> <li>- Protection relays</li> <li>- Auxiliary contactors</li> </ul>			
a.7	<p><b>Country of Manufacture</b></p> <ul style="list-style-type: none"> <li>- Control room boards</li> <li>- Local relay boards</li> <li>- Protection relays</li> <li>- Auxiliary contactors</li> </ul>			

## SCHEDULE VI 4b INFORMATIVE DATA, PROTECTION ETC.

Sheet 1 of 2

CONTROL, PROTECTION, METERING, SIGNALLING				
Item	Particulars	Unit	Data	Reference Doc
b.1	<b>Indicating Instruments</b> To be filled in for each type of instrument: <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type (moving coil, iron type, etc.)</li> <li>- Consumption of internal resistance</li> <li>- Size</li> </ul>	VA/ohm mm		
b.2	<b>Meters</b> To be filled in for each type of meter: <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type</li> <li>- Consumption of internal resistance</li> <li>- Size</li> </ul>	VA/ohm mm		
b.3	<b>Metering Converters (Transducers)</b> To be filled in for each type for converter: <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type</li> <li>- Consumption, current</li> <li>- Consumption, voltage</li> <li>- Time constant</li> <li>- Size</li> </ul>	VA VA ms mm		
b.4	<b>Alarm Annunciators</b> To be filled in for each annunciator panel: <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Type</li> <li>- Number of annunciators</li> <li>- Size of each annunciator (area of the cap)</li> <li>- Total size of panel</li> </ul>	mm mm		
b.5	<b>Control Room Board</b> <ul style="list-style-type: none"> <li>- Height</li> <li>- Width</li> <li>- Length</li> <li>- Relay boards               <ul style="list-style-type: none"> <li>- Height</li> <li>- Width</li> <li>- Length</li> </ul> </li> </ul>	mm mm mm		



## SCHEDULE VI 5b INFORMATIVE DATA, CABLES

Sheet 1 of 2

POWER CABLES, CONTROL CABLES, CABLE RACKS				
Item	Particulars	Unit	Data	Reference Doc
b.1	<b>Low Voltage Cables</b> <ul style="list-style-type: none"> <li>- Conductor material</li> <li>- Insulation material</li> <li>- Armouring/screen</li> <li>- Protective coating</li> <li>- Overall diameter of cable of biggest cable</li> <li>- Weight of heaviest reel, including cable</li> <li>- Size of biggest reel, diameter/width</li> </ul>	    mm kg mm/mm		
b.2	<b>Control and Measuring Cables</b> <ul style="list-style-type: none"> <li>- Conductor material</li> <li>- Insulation material</li> <li>- Armouring/screen</li> <li>- Protective coating</li> <li>- Overall diameter of cable of biggest cable</li> <li>- Weight of heaviest reel, including cable</li> <li>- Size of biggest reel, diameter/width</li> </ul>	    mm kg mm/mm		
b.3	<b>Special Cables</b> To be used for: <ul style="list-style-type: none"> <li>- Relevant informative data</li> </ul>			

## SCHEDULE VI 5b INFORMATIVE DATA, CABLES

Sheet 2 of 2

POWER CABLES, CONTROL CABLES, CABLE RACKS				
Item	Particulars	Unit	Data	Reference Doc
	<b>11 kV Voltage Cables</b> - Conductor material - Insulation material - Armouring/screen - Protective coating - Overall diameter of cable of biggest cable - Weight of heaviest reel, including cable - Size of biggest reel, diameter/width	     mm kg mm/mm		
	<b>33 kV Voltage Cables</b> - Conductor material - Insulation material - Armouring/screen - Protective coating - Overall diameter of cable of biggest cable - Weight of heaviest reel, including cable - Size of biggest reel, diameter/width	     mm kg mm/mm		
	<b>Special Cables, Optical fibre</b> - Relevant informative data			

## SCHEDULE VI 6a TECHNICAL GUARANTEES, EARTHING

Sheet 1 of 1

EARTHING SYSTEM				
Item	Particulars	Unit	Guar. Fig	Reference Doc
a.1	<b>Resistance to Earth of Earthing Electrode System</b> (for each substation) <ul style="list-style-type: none"><li>- Under the control building max.</li><li>- Under the switchyard max.</li><li>- Complete earthing system</li></ul>	ohms ohms ohms		

**SCHEDULE VI 6b INFORMATIVE DATA, EARTHING****Sheet 1 of 1**

EARTHING SYSTEM				
Item	Particulars	Unit	Data	Reference Doc
b.1	<ul style="list-style-type: none"><li>- Reference standard</li><li>- Material of earth conductor</li><li>- Max. temp of any earth conductor during 1 sec. rated phase - ground fault</li><li>- Method of interconnecting earth grid conductors</li></ul>			



**SCHEDULE VI-9a- GAURANTEE DATA TELECOMMUNICATIONS SYSTEM: UHF, Point to Point Radio**

<b>Tender Schedules</b>	<b>Unit</b>	<b>Required</b>	<b>Tendered</b>
<b>General</b>			
Manufacturer of			
• UHF Radio Equipment	-		
• Data communication Equipment, DCE	-		
Type(s) of			
• UHF Radio Equipment	-		
• Data communication Equipment, DCE	-		
Channel size	-		
Transmission mode	-	Full duplex	
Protection class (es) of Radio equipment cards.	-		
<b>Construction Requirements</b>			
Modulation technique:	-	Yes	
Operating range of radio equipment.	kbps	64	
<b>Transmitter parameters</b>			
Output control range	dB		
Freq. Stability	ppm		
Output power	dBm	30	
Residual BER	-	<1 x 10 <sup>-6</sup>	
<b>Interfaces</b>			
Data	-	Acc. To EIA	
Order wire	-	530/G.703	
Ethernet NMS	-	yes	
Config port	-	10 Base T	
Alarms	-	Rs-232 or	
Antennae	Ohms	IP	
		yes	
		50	
EMC		ETS 300 385, FCC Part 15	
<b>System Performance</b>			
Receiver sensitivity (at 10 <sup>-6</sup> BER)	dBm	<-90dbm	
System Gain at 10 <sup>-6</sup> BER	dB	>120dB	

**SCHEDULE VI-9b- GAURANTEE DATA TELECOMMUNICATIONS SYSTEM UHF POINT TO MULTIPOINT RADIO**

<b>Tender Schedules</b>	<b>Unit</b>	<b>Required</b>	<b>Tendered</b>
<b>Remote Radio</b>			
<b>General</b>			
Manufacturer of			
• UHF Radio equipment	-		
• Data communication equipment	-		
Type(s) of			
• UHF Radio equipment	-		
• Data communication equipment	-		
Digital Modulation type	-		
Frequency bands.	MHz	330-512	
Range.	Miles	50	
Data rates (Data)	bps	110-19200, asynchronous	
Transmission mode		Half-duplex	
<b>Transmitter</b>			
Freq. Stability:	ppm		
Carrier power (programmable)	Watts	0.1 to 5	
Duty cycle	-	Continuous	
Output impedance	Ohms	50	
<b>Receiver</b>			
Type	-		
Selectivity.	dB	>70	
Bit error rate @-110dBm RSSI	-	<1 x 10 <sup>-6</sup>	
<b>Interfaces</b>			
Data	-	EIA RS-232	
Diagnostic	-	yes	
<b>Management</b>			
Network wide	-	yes	
Local	-	LED display- RX activity, TX activity, DCD	
<b>Mechanical</b>	ppm		
Rack Mount	-	1 U	
Weight			
<b>Electrical</b>			
Primary power	V	±48 Vdc	
Power required	W	<30 nominal	
<b>Agency Approvals</b>			
Transmission	-	FCC part 90, 74, 22, IC RSS-119	
EMC	-	ETS 300 113, EN, 300, 279	

**SCHEDULE VI-9c- GAURANTEE DATA TELECOMMUNICATIONS SYSTEM UHF POINT TO MULTIPOINT RADIO**

<b>Tender Schedules</b>	<b>Unit</b>	<b>Required</b>	<b>Tendered</b>
<b>VHF 2-Way Base Radio</b>			
<b>General</b>			
Manufacturer of			
• VHF 2-way radios	-		
	-		
Type(s) of			
VHF, 2-way communication devices	-		
	-		
Maximum no. of Channels available	-	Yes	
Extension of no. of channels thro' selector switch. APCO Project 25 compatible	-	Yes	
Protocol	-	Project 25-CAI	
Modulation type.	-	C4FM of QPSK-C	
Frequency Range.	MHz	136-174	
<b>Channel Bandwidth</b>			
Analogue	kHz	12.5/25/30	
Digital	kHz	12.5	
<b>Voice Coder</b>			
Voice coding method		IMBE	
Frame resync interval	msec	180	
Forward Error Correction		Golay code	
<b>Signaling</b>			
Signaling rate	kbps	9.6	
<b>Transmitter</b>			
Rf power	W	10-50	
Max freq Separation	-	Full Band split	
Freq Stability	ppm		
<b>Electrical</b>		acc. to G.823	
Power supply	V	13.8 VDC±20% - veGND	

**SCHEDULE VI-9d- Guaranteed Technical specifications for fig-8 and OPGW Particular technical specifications Telecommunication) fiber optic cable**

Particulars	Unit	Employer's requirement	Tender value
Number of fibres	OPGW	$\geq 48$	
	ADSS	$\geq 24$	
Core diameter	$\mu\text{m}$	8.3 or 9 with a 3% tolerance	
Cladding design, either matched or depressed			
Clad diameter	$\mu\text{m}$	$125.0 \pm 2$	
Core-clad concentricity		$< 2\%$	
Coating diameter	$\mu\text{m}$	$250.0 \pm 15$	
Coating concentricity	$\geq$	0.70	
Attenuation: 1310 nm 1550 nm	dB/km	$\leq 0.40$ $\leq 0.25$	
Bending attenuation: 1310 nm 1550 nm	dB/km	$\leq 0.40$ $\leq 0.25$	
Temperature dependence	dB/km	$\leq 0.05$ (-20°C- +85°C)	
Cut-off wavelength	nm	$\leq 1250$	
Chromatic dispersion:			
Zero dispersion at	nm	$1310 \pm 12$ $1550 \pm 15$	
Zero dispersion slope (max.)	ps/nm <sup>2</sup> (km)	0.092 0.085	
Mode field diameter:			
1300 nm	mm	$9.30 \pm 0.50$	
1550 nm	mm	$10.50 \pm 1.00$	
IL-proof test level	g/m <sup>2</sup>	$35 \times 10^6$	
Splice attenuation	dB/ splice	0.02	
Connector loss	dB/connect or	$< 0.5$	
<i>ODF</i>			
Manufacturer	-		
Type	-		
Number of fiber interconnections	-	96 48	
Connector loss	dB/connect or	$< 0.5$	
Screw on type connectors designed for 19" cubicles	- -	yes yes	

## SCHEDULE VI-9e- Guaranteed Technical specifications for PLC

Particulars	Unit	Employer's requirement	Tender value
Manufacturer			
Type			
Number of speech channels per link (analogue)	min.	1	
“ “ ditto (analogue, for 8 kHz bandwidth)	min.	3	
“ “ ditto (digital)	min.	8	
Number of data channels per link (analogue)	min.	4	
“ “ ditto (digital)	min.	8	
Compatibility with existing analogue PLC equipment		yes	
S/N ratio for complete link (without companders)	dB	>35	
Line attenuation	dB		
Carrier frequency range	kHz	40 - 500	
Gross channel bandwidth	kHz	4 / 8	
Usable AF bandwidth	Hz	300 - 3600	
Max. usable data transmission rate	kBit/s	76.8	
RF output power	W PEP		
Spurious emission suppression	dB		
Selectivity of receiver	dB		
Automatic gain control		yes	
RF level range	dB		
Number of teleprotection commands			
Protection class of equipment racks, cubicles			
<i>EMC standards:</i>			
• EN 50081-2, class A		yes	
• EN 50082-2			
<i>Power supply:</i>			
• Supply voltage	VDC	48 + 20% - 15%	
• Power consumption	W		
<i>Ambient conditions:</i>			
(according to IEC 721-3)		yes	

**SCHEDULE VI-9f- Guaranteed Technical specifications SDH Multiplexer and Access Multiplexer**

Particulars	Unit	Employer's requirement	Tender value
<i>General</i>			
Manufacturer			
• N x 2 MBit multiplexer equipment	-		
• terminal equipment	-		
Type(s) of			
• N x 2 MBit multiplexer	-		
• terminal equipment	-		
Maximum extension of transmission capacity of individual terminal by adding plug in cards.	-		
Ditto. for multiplexer based on 2 MBit-hierarchy.	-		
Maximum extension for multiplexer and terminal equipment racks.	-		
Protection class(es) of terminal equipment racks.	-		
<i>Construction Requirements</i>			
Operating principle of amplifiers: optical - optical (bit rate insensitive)	-	Yes	
Operating range of fibre optic terminals.	MBit/s	155 (STM-1)	
Operating principle of optical transmitter.			
<i>Optical Parameters</i>			
Nominal operating wavelength.			
Remaining overall system margin at start of life/end of life.			
Receiver sensitivity (at BER of $10^{-10}$ ) at start of life/end of life.			
<i>Transmission Parameters</i>			
Bit error rate (path including terminals) at			
• n x 2 MBit/s	-	$<1 \times 10^{-10}$	
Jitter performance			
• n x 2 MBit/s		acc. to G.823	
Accuracy of internal clock	ppm		
Line code (optical)			
Line code (electrical)			
ITU/CCITT standards (PCM equipment)			



	Feature	Minimum requirement	Tendered offer
		<b>AL TECH. SPECIFICATIONS</b>	<b>CENTRAL CONSTRUCTION</b>
	Maximum Operating Load	9000 N	
	Minimum Bending Radius Installation	20xO.D. 10xO.D.	
	Long Term		
	Max. Compressive Loading	4000 N / 10 cm	
	Impact Resistance	4.4 J, 3 x 2 times	
	Twist (Torsion)	10 turns of 180° on 125xO.D.sample, both ways.	
	Storage Temperature Range	- 50° C to +70° C	
	Operating Temperature Range	- 40° C to +70° C	
	Core Fluid Penetration	1 m sample, 1 m water head for 24 Hrs	
	Distance Between Poles	Up to 100M	
	Warranty	15 years	
	UV Resistance		
	Outer Cable Markings	Property of Kenya Power & Lightning Company	
	Packing	Rolls for various sections to be determined by distance between section poles but not less than 1000M	
	Length marking	Every meter	
	Color	016 Grey (to make it unique) <b>KENYA POWER</b>	
	Performance	Allowed attenuation per Km for the 9/125	

**SCHEDULE VI-9d- Guaranteed Technical specifications for ADSS specified in particular technical specification -Gauranteed General specifications for Approach cable**

item	Feature	Description	Tendered offer
1	Maximum Operating Load	9000	
2	Minimum Bending Radius Installation Long Term	20xO.D. 10xO.D.	
	Max. Compressive Loading	4000 N / 10 cm	
3	Impact Resistance	4.4 J, 3 x 2 times	
4	Twist (Torsion)	10 turns of 180° on 125xO.D. sample, both ways.	
5	Storage Temperature Range	- 50° C to +70° C	
6	Operating Temperature Range	- 40° C to +70° C	
7	Core Fluid Penetration	1 m sample, 1 m water head for 24 Hrs	
8	Warranty	15 years	
9	Manufacturer Factory Location		
10	UV Resistance		
11	Outer Cable Markings	Property of Kenya Power & Lightening Company	
12	packing	Rolls of 1000M per drum	
13	Length marking	Every meter	
14	Color	Grey (to make it unique)	
15	Performance	Loss	

**SCHEDULE VI-9e- Guaranteed Technical specifications for ADSS specified in particular technical specification -GauranteedGeneral specifications for Optical Distribution frame (ODF)**

	Feature	Minimum requirement	Tendered offer
	Fiber optic ODF	Fiber optic patch panel 48 ports SM wall mounted with enclosure	
		splice tray cassette,	
		pigtails terminated on SC connectors	