

**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 .....	9
SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR .....	13
SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR .....	16
SCHEDULE VI 3a TECHNICAL GUARANTEES, CONTROL SYSTEM .....	19
SCHEDULE VI 3b INFORMATIVE DATA, CONTROL SYSTEM .....	20
SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.....	21
SCHEDULE VI 4b INFORMATIVE DATA, PROTECTION ETC.....	27
SCHEDULE VI 5b INFORMATIVE DATA, CABLES.....	29
SCHEDULE VI 5b INFORMATIVE DATA, CABLES.....	30
SCHEDULE VI 6a TECHNICAL GUARANTEES, EARTHING.....	31
SCHEDULE VI 6b INFORMATIVE DATA, EARTHING.....	32
<b>TECHNICAL SCHEDULES TRANSFORMERS .....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
SCHEDULE VI 7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS.....	<b>Error! Bookmark not defined.</b>
SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMERS .....	40
SCHEDULE VI 8a - TECHNICAL GUARANTEES, DISTRIBUTION TRANSFORMERS .....	49
SCHEDULE VI-8b - INFORMATIVE DATA, DISTRIBUTION TRANSFORMER .....	51
<b>SCHEDULE VI-9A- INFORMATIVE DATA TELECOMMUNICATION SYSTEM....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
SCHEDULE VI-9B- INFORMATIVE DATA TELECOMMUNICATION SYSTEM .....	53

## **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	66KV	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		
Item	Particulars	Unit	Guar. Fig		Reference Doc
	<p><b>Circuit breakers continued</b></p> <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>	<p>A</p> <p>kA rms</p> <p>kA peak</p> <p>m.sec.</p> <p>m.sec.</p> <p>m.sec.</p> <p>m.sec.</p> <p>kV/msec</p> <p>kV/msec</p> <p>°C</p>			
a.3	<p><b>Earthing Switches</b></p> <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		
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>	<ul style="list-style-type: none"> <li>kV</li> <li>kV</li> <li>Hz</li> <li>kV rms</li> <li>kV rms</li> <li>kV peak</li> <li>A</li> <li>A</li> <li>kA rms</li> <li>kA peak</li> </ul>			
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>	<ul style="list-style-type: none"> <li>kV</li> <li>kV rms</li> <li>kV rms</li> <li>kV rms</li> <li>kV peak</li> <li>kV</li> </ul>			
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, INDOOR MV INDOOR SWITCHGEAR**

**Sheet 1 of 6**

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

**Sheet 2 of 6**

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

Sheet 3 of 6

**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	<b>Cubicles</b> Manufacturer  - Rated Voltage - Maximum service voltage - Rated frequency - Rated continuous busbar current - One minute power frequency withstand voltage, dry and wet - to earth - Impulse withstand voltage 1.2/50 ms - to earth - Permissible 1 second short-time current - Dynamic short-time current Arch tested in accordance with IEC 60280 amendment 2	kV kV Hz A  kV rms  kV peak kA rms kA peak Yes/no			
a.6	<b>Country of Manufacture</b> - Cubicles				

**SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR**

**Sheet 1 of 6**

**SCHEDULE VI-2bINFORMATIVE DATA, MV INDOOR SWITCHGEAR**

**Sheet 2 of 6**



**SCHEDULE VI-2bINFORMATIVE DATA, MV INDOOR SWITCHGEAR**

**Sheet 3 of 6**

**SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR**

**Sheet 4 of 6**

**SCHEDULE VI-2bINFORMATIVE DATA, MV INDOOR SWITCHGEAR**

**Sheet 5 of 6**

**SCHEDULE VI-2bINFORMATIVE DATA, MV INDOOR SWITCHGEAR**

**Sheet 6 of 6**

## SCHEDULE VI 3a TECHNICAL GUARANTEES, CONTROL SYSTEM

Sheet 1 of 1

SUBSTATION CONTROL SYSTEM (SCS)			
Item	Particulars	Unit	Guar. Fig
a.1	<p><b>Control system response and update time under "moderate load" conditions</b></p> <p>The control system shall be designed to yield the following response and update times under "moderate load" conditions</p> <ul style="list-style-type: none"><li>- Time taken to completely refresh data held with the SCS:<ul style="list-style-type: none"><li>a. maximum</li><li>b. average</li></ul></li><li>- Time taken to carry out a complete status check of all indications and alarms<ul style="list-style-type: none"><li>a. maximum</li><li>b. average</li></ul></li><li>- The time between selection and display of a VDU diagram fully updated from the existing main computer data base shall not exceed</li><li>- The time between selection of a control function and check back shall not exceed</li><li>- The time between execution of a control function and successful completion being displayed at the Operation Workshop shall not exceed for<ul style="list-style-type: none"><li>a. Circuit breaker (operating time = 250 ms)</li><li>b. Isolator (operating time = 10s)</li></ul></li><li>- The time between the occurrence of the first change of state/alarm and display at the Operator Workstation shall not exceed</li><li>- The time between selecting display of analogue measurements and the corresponding value in the database being displayed shall not exceed</li><li>- The time between successive updates of the data base with analogue measurements shall not exceed<ul style="list-style-type: none"><li>a. Network MW measurements</li><li>b. Other analogue measurements</li></ul></li></ul>	s s s s s s s s s	
a.2	<p><b>Equipment Reliability</b></p> <p>Mean time between failure shall be not less that:</p> <ul style="list-style-type: none"><li>- Each computer</li><li>- VDU</li><li>- Logging printer</li><li>- System console</li><li>- Communication system</li></ul>	h h h h h	

## 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 max. mm 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>	<ul style="list-style-type: none"> <li>%</li> <li>%.I<sub>N</sub></li> <li>%.I<sub>N</sub></li> </ul>		
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>	<ul style="list-style-type: none"> <li>%</li> <li>%</li> <li>%</li> <li>%</li> <li>%.I<sub>N</sub></li> </ul>		
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>	<ul style="list-style-type: none"> <li>%</li> <li>%</li> <li>%.I<sub>N</sub></li> <li>%.I<sub>N</sub></li> <li>%.I<sub>N</sub></li> <li>%.I<sub>N</sub></li> </ul>		

## 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>		



- Stability against Switching inrush currents and Reverse faults.
- Clear faulted phase indication.
- Clear fault identification even for boundary conditions.
- Software necessary for all above functions shall be provided.
- Three sets of Installation, Commissioning and maintenance manuals shall be provided.

Three phase numeric directional over current and earth fault relay

Shall incorporate the following features:

- Relay must be of Numerical design.
- Current setting range for over current relay 0.5In-2.4In
- Current setting range for earth fault relay 0.05In-0.8In
- Quadrature connection for polarising voltage ( $V_n=110$ )
- Applicable on the LV side of a Dyn1 transformer
- High set Element, with a setting range of 1-32In
- The phase and earth directional elements should be individually selectable.
- I.D.M.T characteristics according to BS 142 or IEC 60255 and Definite time characteristic
- The normal operating boundary shall be  $\pm 90$  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.
- Time setting multiplier 0.05 - 1.0
- Broken conductor protection feature
- Negative sequence Protection Feature
- Highset Element for both over current and earth fault Protection, with a setting range of 1-30In.
- Thermal Protection.
- Dedicated Breaker Fail Protection.
- Circuit Breaker Maintenance
- Incorporate Fault records, Event Records and disturbance records.
- Configurable output relays with ability to output starting elements to control Tripping of other upstream Protection relays.
- Must provide all technical and operations manuals and configurations and settings software.

Shall incorporate all the features as listed

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> <ul style="list-style-type: none"> <li>- Accuracy of the adjustable tripping time sec.</li> <li>- Min. possible tripping time ms</li> <li>- Drop out ratio %</li> <li>- Directional sensitivity (dist. relay only) %<math>.U_N</math></li> <li>- Max. admissible current during 0.5 sec. %<math>.I_N</math></li> <li>- Max. admissible current continuously %<math>.I_N</math></li> <li>- Relation between tripping coil current and holding coil current (diff. relay only) %</li> <li>- Limit value of the adjustable tripping current (O.C.R.) %<math>.I_N</math></li> <li>- Limit value of the instantaneous tripping current (O.C.R.) %<math>.I_N</math></li> <li>- Limit value of the adjustable tripping voltage (O.V.R.) %<math>.I_N</math></li> <li>- Limit value of the instantaneous tripping voltage (O.V.R.) %<math>.I_N</math></li> </ul> <p><u>Biased differential protection for a two winding transformer.</u></p> <ul style="list-style-type: none"> <li>• Relay Must be of Numerical design</li> <li>• Pick up setting range, 0.1 to 0.5<math>I_n</math></li> <li>• Should incorporate a high-set Element with a setting range of up to 20<math>I_n</math>.</li> <li>• Magnetising current inrush restraint</li> <li>• Integral CT ratio compensation (0.1-2) and vector group compensation</li> <li>• Measurement and indication on the MMI, of phase, differential and bias currents</li> <li>• Storage of Fault records and Event records; the Fault flags should be accessible on the relay LCD screen without opening the relay cover.</li> <li>• Overfluxing restraint</li> <li>• Overfluxing protection with Alarm and Trip functions</li> <li>• 5th harmonic restraint feature on the differential Element.</li> <li>• Appropriate Dual Bias characteristic to ensure relay stability for heavy through faults</li> <li>• Should incorporate a disturbance recorder feature.</li> <li>• Red L.E.D to indicate Tripping</li> <li>• Relay Self diagnostic and Alarm feature</li> <li>• Ability to Latch output contacts to prevent TX re-energizing before carrying out investigations .</li> </ul>			
-----	--	--	--	--

	<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>		
--	---	---	--	--

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

## CONTROL, PROTECTION, METERING, SIGNALLING

Item	Particulars	Unit	Guar. Fig	Reference Doc
a.5	<b>Auxiliary Circuit Breakers</b> - To be filled in for each type of AC and DC breaker: - Min. operating voltage - Max. operating voltage - Drop out voltage - Service life (min. number of contact operation)	 %. $U_N$ %. $U_N$ V		
a.6	<b>Manufacturer's Name</b> - Control room boards - Local relay boards - Protection relays - Auxiliary contactors			
a.7	<b>Country of Manufacture</b> - Control room boards - Local relay boards - Protection relays - Auxiliary contactors			

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

Sheet 1 of 2

CONTROL, PROTECTION, METERING, SIGNALLING				
Item	Particulars	Unit	Data	Reference Doc
b.1	<p><b>Indicating Instruments</b></p> <p>To be filled in for each type of instrument:</p> <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	<p><b>Meters</b></p> <p>To be filled in for each type of meter:</p> <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	<p><b>Metering Converters (Transducers)</b></p> <p>To be filled in for each type for converter:</p> <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	<p><b>Alarm Annunciators</b></p> <p>To be filled in for each annunciator panel:</p> <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	<p><b>Control Room Board</b></p> <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 4b INFORMATIVE DATA, PROTECTION ETC.

Sheet 2 of 2

CONTROL, PROTECTION, METERING, SIGNALLING				
Item	Particulars	Unit	Data	Reference Doc
b.6	<p><b>Protection Relays</b></p> <p>To be <b>copied</b> and filled in for each relay with the applicable items of the data below:</p> <p>Relay for _____:</p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Consumption</li> <li>- Limit values of the adjustable tripping time</li> <li>- Limit values of the adjustable sensitivity</li> <li>- Limit values of the adjustable operating quantity (current, voltage, frequency, etc.) in % of normal</li> <li>- Limit values of the instantaneous operating quintet in % of nominal value</li> <li>- Size</li> </ul> <p>For distance relay only:</p> <ul style="list-style-type: none"> <li>- Starting impedance adjustable between</li> <li>- Earth fault tripping current adjustable between</li> </ul>	<p>VA</p> <p>sec.</p> <p>%</p> <p>%</p> <p>%</p> <p>mm</p> <p>ohm/ph</p> <p>x.I<sub>N</sub></p>		
b.6	<p><b>Protection Relays</b></p> <p>To be filled in for each relay with the applicable items of the data below:</p> <p>Relay for _____:</p> <ul style="list-style-type: none"> <li>- Reference standard</li> <li>- Consumption</li> <li>- Limit values of the adjustable tripping time</li> <li>- Limit values of the adjustable sensitivity</li> <li>- Limit values of the adjustable operating quantity (current, voltage, frequency, etc.) in % of normal</li> <li>- Limit values of the instantaneous operating quintet in % of nominal value</li> <li>- Size</li> </ul> <p>For distance relay only:</p> <ul style="list-style-type: none"> <li>- Starting impedance adjustable between</li> <li>- Earth fault tripping current adjustable between</li> </ul>	<p>VA</p> <p>sec.</p> <p>%</p> <p>%</p> <p>%</p> <p>mm</p> <p>ohm/ph</p> <p>x.I<sub>N</sub></p>		

## 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> <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>33 kV 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>66 kV 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>Special Cables, Optical fibre</b> <ul style="list-style-type: none"> <li>- Relevant informative data</li> </ul>			



## 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-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS

Sheet 2 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
7.	Load losses at 75°C at rated currents, the third winding being open:				
	HV - LV, ONAN	kW	-		
	HV - TV, ONAN	kW	-		
	LV - TV, ONAN	kW	-		
	HV - LV, ONAF	kW	-		
	HV - TV, ONAF	kW	-		
	LV - TV, ONAF	kW	-		
8.	Cooling plant power consumption	kW			
9.	Total losses at 75°C on principal tapping and unity power factor and rated currents:				
	ONAN	kW			
	ONAF including input to cooling plant	kW			
10.	Impedance voltages at 75° referred to mutual capacities at rated frequency and 100% rating:				
	Principal tapping:				
	HV - LV, ONAN	%			
	HV - TV, ONAN	%	-		
	LV - TV, ONAN	%	-		
	HV - LV, ONAF	%	-		
	HV - TV, ONAF	%	-		
	LV - TV, ONAF	%	-		

**SCHEDULE VI-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS** Sheet 3 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
	Extreme plus tapping:				
	HV - LV, ONAN	%			
	HV - TV, ONAN	%	-		
	LV - TV, ONAN	%	-		
	HV - LV, ONAF	%			
	HV - TV, ONAF	%	-		
	LV - TV, ONAF	%	-		
	Extreme minus tapping:				
	HV - LV, ONAN	%			
	HV - TV, ONAN	%	-		
	LV - TV, ONAN	%	-		
	HV - LV, ONAF	%			
	HV - TV, ONAF	%	-		
	LV - TV, ONAF	%	-		
11.	Temperature rise after continuous operation with rated MVA, under the ambient conditions specified in Section VI, Clause 4.1.3.2.1 and the rated conditions giving the highest losses:				
	Top oil (by thermometer)	°C			
	Windings (by resistance)	°C			
12.	Efficiency on principal tapping max. temperature of winding and unity power factor and TV winding open:				
	- 120% load, ONAN	%			
	- 100% load, ONAN	%			
	- 50% load, ONAN	%			
	- 120% load, ONAF	%			
	- 100% load, ONAF	%			
	- 50% load, ONAF	%			

**SCHEDULE VI-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS** Sheet 4 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
13.	Inherent voltage regulation on principal tapping, 75°C and unity power factor:				
	- TV winding open	%			
	- 80% of full load on LV winding and 20% on TV winding	%			
14.	Inherent voltage regulation on principal tapping, 75°C and 0.8 power factor lagging:				
	- TV winding open	%			
	- 80% of full load on LV winding and 20% on TV winding	%			
15.	Vector group	-			
16.	No. of phases per transformer	-			
17.	Type of cooling	-			
18.	Whether star connected windings shall be fully insulated or graded				
	- HV winding	-			
	- LV winding	-			
19.	Insulation levels of star points				
	- HV winding	kV			
	- LV winding	kV			
20.	Method of system earthing:				
	- HV system	-			
	- LV system	-			

**SCHEDULE VI-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS** Sheet 5 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
21.	Method of transformer earthing: - HV windings - star point - LV windings - star point - TV winding - one corner of closed delta	- - -			
22.	Whether TV windings are to be brought out to separate bushing insulators	-			
23.	Indoor or outdoor installation	-			
24.	System highest voltage according to IEC: - HV - LV - TV	kV kV kV	-		
25.	Maximum flux density at rated voltage on principal tapping and rated frequency: - Transformer legs - Transformer yokes	T T			
26.	Maximum flux density at most onerous voltage and frequency conditions: - Transformer legs - Transformer yokes	T T			
27.	Specific core loss	W/kg			

**SCHEDULE VI-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS** Sheet 6 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
28.	Maximum current density in windings at rated output:				
	HV, higher voltage, ONAN	A/mm <sup>2</sup>			
	HV, lower voltage, ONAF	A/mm <sup>2</sup>			
	LV, ONAN	A/mm <sup>2</sup>			
	LV, ONAF	A/mm <sup>2</sup>			
	TV, ONAN	A/mm <sup>2</sup>			
	TV, ONAF	A/mm <sup>2</sup>			
29.	Magnetising current at rated nominal voltage on principal tapping	A			
30.	Maximum hot spot temperature of winding	°C			
31.	Equivalent resistance referred to HV side	ohms			
32.	Equivalent reactance referred to HV side	ohms			
33.	Maximum current carrying capacity of bushings:				
	HV	A			
	LV	A			
	TV	A			
34.	Rated service voltage of bushings:				
	HV	kV			
	LV	kV			
	TV	kV			
	HV, neutral	kV			
	LV, neutral	kV			



**SCHEDULE VI-7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS** Sheet 7 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	Description	Unit	7.5MVA	2.5MVA	
35.	1 minute, 50 Hz dry withstand voltage:				
	HV bushing	kV			
	LV bushing	kV			
	TV bushing	kV			
	HV, LV neutral bushings	kV			
36.	1 minute, 50 Hz wet withstand voltage:				
	HV bushing	kV			
	LV bushing	kV			
	TV bushing	kV			
	HV, LV neutral bushings	kV			
37.	Impulse withstand voltage:				
	HV bushing	kV			
	LV bushing	kV			
38.	Maximum noise level				
	- Transformer and tap changing equipment energised and at no-load with ONAN cooling	dB			
	- Same as above but with ONAF cooling (fans running)	dB			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMERS

Sheet 1 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
1.	Type of transformer (core or shell type)	-			
2.	Number of core legs	-			
3.	Type of windings:				
	HV	-			
	LV	-			
	TV	-			
4.	Type of insulation:				
	HV, winding	-			
	LV, winding	-			
	TV, winding	-			
	Tappings				
	Tapping connection	-			
	Core bolts (if any)	-			
	Core bolt washers (if any)	-			
	Core lamination designation	-			
	Specific core loss	w/cm <sup>3</sup>			
5.	Type of axial coil supports:				
	HV winding	-			
	LV winding	-			
	TV winding	-			
6.	Winding conductor material	-			
	HV	-			
	LV	-			
7.	Type of joints in the magnetic core (butt type, interleaved etc.)				
8.	Calculated thermal time constant:				
	ONAN	hours			
	ONAF	hours			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 2 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
9.	Type of bushings:				
	HV	-			
	LV	-			
	TV	-			
	HV, LV neutral	-			
10.	Principal bushing insulator materials:				
	HV	-			
	LV	-			
	TV	-			
	HV, LV neutral	-			
11.	Total creepage distance over porcelain externally:				
	HV bushing	mm			
	LV bushing	mm			
12.	Protected leakage distance over porcelain externally (90° shadow)				
	HV bushing	mm			
	LV bushing	mm			
13.	Thickness of transformer tank:				
	Sides	mm			
	Bottom	mm			
	Top	mm			
14.	Thickness of radiator plates	mm			
15.	Number of radiators per transformer	-			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 3 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
16.	On-load tap changer:				
	Type (resistor type, reactor type, etc.)	-			
	Total number of tappings including principal	-			
	Rated currents of:				
	- Selector switch	A			
	- Diverter switch	A			
	- Resistors	A			
	Maximum overcurrent of:				
	- Selector switch	A			
	- Diverter switch	A			
	- Resistors	A			
	Driving motor input	kW			
	Type of driving motor (3-phase etc.)	-			
	Monitoring contact:				
	- Closing time in advance of parting of diverter switch	sec.			
	- Opening time after diverter switch contacts have fully opened	sec.			
	Diverter switch opening time	sec.			
	Time from "point of no return" to parting of diverter switch contacts	sec.			
17.	Whether outdoor cabinets/kiosks are provided with heaters	-			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 4 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
18.	Forced air cooling system:				
	State if fans are blowing directly on radiators	-			
	Total number of fan units per transformer	-			
	Cooling capacity of each complete cooling system	kW			
19.	Total oil quantity in completely filled transformer	kp			
20.	Total weight of oil in completely filled transformer	l			
21.	Total oil quantity in conservator	l			
22.	Total quantity of oil in conservator between highest and lowest level	l			
23.	Volume of conservator tank	l			
24.	Weight of copper in windings	kg			
25.	Weight of core/winding assembly	kg			
26.	Weight of each radiator:				
	Filled with oil	kg			
	Empty	kg			
27.	Total weight of bushings:				
	HV	kg/each			
	LV	kg/each			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 5 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
28.	Total weight of complete transformer erected at site	tons			
29.	Weight of transformer as arranged for transport	tons			
30.	Filling medium during transport	-			
31.	Overall dimensions of transformer completely erected at site, including bushings, radiators:				
	Length	mm			
	Width	mm			
	Height	mm			
32.	Overall dimensions of transformer arranged for transport:				
	Length	mm			
	Width	mm			
	Height	mm			
33.	Maximum lift of core/winding assembly incl. lifting beam, slings, etc. for untanking	mm			
34.	Rated output per fan unit	m <sup>3</sup> /min.			
35.	Speed of fan motors	rpm			
36.	Continuous rating of fan motors	Hp			
37.	Starting current of fan motors	A			

**SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER**

Sheet 6 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
38.	Efficiency of fan motors	%			
39.	Power factor of fan motors at rated output	%			
40.	Material in rating and diagram plates	-			
41.	Are on-load tap changing equipment prepared for fully automatic operation	-			
42.	Are on-load tap changing equipment prepared for local, remote control (control room) and supervisory (NCC) operation and indication	-			
43.	Are on-load tap changing equipment prepared for fully automatic parallel operation with similar transformers	-			
44.	Whether first filling of oil is included	-			
45.	Whether tap changer cubicle and wiring cabinet are provided	-			
46.	Whether winding, and top oil indicators are provided	-			
47.	Whether cooling fans are automatically operated from the winding temperature indicators	-			
48.	Whether pressure relief device is to be fitted	-			
49.	Whether Buchholz relay is fitted	-			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 7 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit		___MVA	___MVA
50.	Whether all internal cabling/wiring on transformer is supplied to form a complete self contained unit	-			
51.	Are the following alarms/trip signals provided:	-			
	Tap changer not operating, alarm	-			
	Tap changers out of step, alarm	-			
	Voltage transformer failure	-			
	Fan failure, alarm	-			
	Oil/gas flow transformer, alarm	-			
	Oil/gas flow transformer, trip	-			
	On load tap changer protective relay operated, trip	-			
	Oil gauge low level, alarm	-			
	Oil gauge low level, trip	-			
	Tap changer oil gauge level low, alarm	-			
	Tap changer oil gauge level critical, trip	-			
	Top oil temp. high, alarm	-			
	Top oil temp. critical, trip	-			
	Winding temp. high, alarm	-			
	Winding temp. critical, trip	-			
52.	Are the following temperature indicators provided:				
	HV winding	-			
	LV or common winding				
	TV winding				



## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 8 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit		___MVA	___MVA
53.	Are the following oil level gauges provided: - Main conservator tank - On-load tap changer conservator tank	- -			
54.	Tap change indicator provided	-			
55.	Tap change in progress indicator	-			
56.	Tap changer out of step indicator	-			
57.	Potentiometer switch for remote/supervisory on-load tap changer position indicator	-			
58.	Will the tests specified in Section 3-II - Clause 10 be adhered to? If deviations, please state underneath	-			

## SCHEDULE VI-7b - INFORMATIVE DATA, POWER TRANSFORMER

Sheet 9 of 9

HV POWER TRANSFORMERS					
Item	Description	Unit	7.5MVA	2.5MVA	
59.	State all Standards applied underneath:				
60.	<p>State identity of transformer manufacturer and all sub-manufacturers including the parts manufactured below:</p> <p>Transformer:  Cooling equipment  On-load tap changer  Current transformers  Bushings  Core steel  Oil  Buchholz relay  Breather  Thermometer</p> <p>Other equipment to be listed by the Bidder:</p> <p>- - - - -</p>				

## SCHEDULE VI 8a - TECHNICAL GUARANTEES, DISTRIBUTION TRANSFORMERS

Sheet 1 of 2

DISTRIBUTION TRANSFORMER			Guaranteed Data	
Item	Particulars	Unit		33/0.4 kV
1.	Continuous Maximum Rating C.M.R.	kVA		
2.	Normal voltage between phases at no load			
	a) H.V.	Volts		
	b) L.V.	Volts		
3.	Tappings			
	a) Plus	%		
	b) Minus	%		
4.	Performance Data at Sea Level, corrected at 75%			
	a) No load loss at normal primary voltage	watts		
	b) No load loss at 10% primary over voltage	watts		
	c) Load loss at C.M.R.	watts		
	d) Impedance volts at C.M.R. and normal ratio	%		
	e) Regulation at C.M.R. and unity power factor	%		
	f) Regulation at C.M.R. and 0.8 power factor	%		
	g) Max temperature rise at C.M.R.:			
	i) Top oil by thermometer	°C		
	ii) Average winding by resistance			
	iii) "Hot Spot" corresponding to (ii)			

**SCHEDULE VI-8a - TECHNICAL GUARANTEES, DISTR. TRANSFORMERS** Sheet 2 of 2

DISTRIBUTION TRANSFORMER			Guaranteed Data	
Item	Particulars	Unit		33/0.4 kV
5.	Type of insulation used on windings a) H.V. b) L.V.			
6.	Lightning Impulse Insulation level of: a) H.V. winding b) L.V. winding c) Tap change equipment and connections i) To earth ii) Between contacts	kVpk kVpk kVpk kVpk		
7.	Are test certificates supplied supporting the level stated in Clause 6	Yes/No		
8.	Silica gel Breather a) Make of unit fitted b) Size of unit			

## SCHEDULE VI-8b - INFORMATIVE DATA, DISTRIBUTION TRANSFORMER

Sheet 1 of 2

DISTRIBUTION TRANSFORMER				
Item	Particulars	Unit		33/0.4 kV
1.	Transformer type (sealed or breathing)			
2.	Type of windings HV LV			
3.	Type of insulation HV winding LV winding			
4.	Type of tap changer			
5.	Tap changer designation			
6.	Type of axial coil supports HV winding LV winding			
7.	Winding conductor material HV winding LV winding			
8.	Core laminations designation	-		
9.	Specific core loss	w/cm <sup>3</sup>		
10.	Type of bushings HV LV			

**SCHEDULE VI-8b - INFORMATIVE DATA DISTRIBUTION TRANSFORMERS** Sheet 2 of 2

DISTRIBUTION TRANSFORMER				
Item	Particulars	Unit		33/0.4 kV
11.	Bushing insulator material HV LV			
12.	Creepage distance across bushings HV LV	mm mm		
13.	Type of cooling system			
14.	Total oil quantity	k		
15.	Total weight			
16.	Volume of conservator tank	l		
17.	Overall dimensions Length Width Height	mm mm mm		
18.	State all standards applied underneath:			
19.	State identity of manufacturer underneath:			

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

Tender Schedules	Unit	Required	Tendered
<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	-	$<1 \times 10^{-6}$	
<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
		<i>AL TECH. SPECIFICATIONS</i>	<i>CENTRAL CONSTRUCTION</i>
	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	<b>016</b> 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)	
1	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	

