SECTION VI

TECHNICAL SCHEDULES

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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	**Circuit Breakers** (Type _____)				
	Breaking Medium	SF_6/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
	Circuit breakers continued				
	- Overvoltage factor for disconnection of unloaded transformers (without voltage limitation by lightning arresters)				
	- Rated inductive current switching capacity	A			
	- Permissible 1 second short-time current	kA rms			
	- Dynamic short-time current	kA peak			
	- 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	m.sec.			
	- Make time, interval of time between the initiation of closing operation and the instant when the current begins to flow in the main circuit	m.sec.			
	- Total break time, interval of time between the instant of application of tripping impulse to the instant of final arc extinction in all poles				
	- at 100% breaking capacity	m.sec.			
	- under phase opposition	m.sec.			
	- Rate of rise of recovery voltage (RRRV) at 100% short circuit current				
	- 3-phase	kV/msec			
	- 1-phase				
	- RRRV out of phase duty	kV/msec			
	- Minimum temperature rise at rated current of main contact	°C			
a.3	**Earthing Switches**				
	- Rated short-time current 1 sec.	kA rms			
	- Rated dynamic short-circuit current				
	- Making Capacity				

Outdoor Switchgear		**33kV**		
Particulars	**Unit**	**Guaranteed figure**	**Tolerance**	**11KV Guar. Fig**
Autoreclosers				
Breaking medium				
Manufacturer				
- Normal system voltage				
- Maximum service voltage	kV			
- Rated frequency	Hz			
- Rated continuous current	A			
- Short time withstand current and time	A, s			
- Rated power frequency withstand voltage, 50Hz, 60s wet	kV rms			
- Rated lightning impulse withstand voltage, 1.2/50µs dry	kV peak			
- Minimum number of mechanical & full load operations				
- Interrupter contact life				
- Switch operating times				
Open				
Close				

SCHEDULE VI-1a TECHNICAL GUARANTEES, OUTDOOR SWITCHGEAR

Sheet 3 of 4

OUTDOOR SWITCHGEAR			33 kV	11kv	
Item	Particulars	Unit	Guar. Fig	Guar. Fig	Reference Doc
a.4	**Current Transformers**				
	Manufacturer				
	- Rated voltage	kV			
	- Maximum service voltage	kV			
	- Rated frequency	Hz			
	- One-minute power frequency test voltage of				
	- primary winding	kV rms			
	- secondary winding	kV rms			
	- Lightning impulse withstand voltage	kV peak			
	- Rated primary currents	A			
	- Rated secondary current	A			
	- Short-time thermal rating				
	- 1 second	kA rms			
	- Short-time dynamic rating	kA peak			
	- Burden and accuracy class of				
	- measuring core				
	- protection core				
	- Instrument security factor of the measuring core				
	- Accuracy limit factor of the				
	- protection core				
a.5	**Voltage Transformers**, Type _____				
	Manufacturer				
	- Rated voltage	kV			
	- Maximum service voltage	kV rms			
	- One-minute power frequency test voltage				
	- primary winding	kV rms			
	- secondary winding	kV rms			
	- Lightning impulse withstand voltage	kV peak			
	- Burden and accuracy class of				
	a. measuring winding protection winding				
	- Ratio	kV			
a.6	**Country of Manufacture**				
	- Cubicles				
	- Circuit breakers				
	- Current transformers				
	- Voltage transformers				

SCHEDULE VI-1b INFORMATIVE DATA OUTDOOR SWITCHGEAR

Sheet 1 of 3

Item	Particulars	Unit	33 kV	
b.2	**Circuit Breakers**			
	- 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-1b INFORMATIVE 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_6 breakers			
	- Normal gas density for SF6 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-1b INFORMATIVE DATA, OUTDOOR SWITCHGEAR Sheet 3 of 3

Item	Particulars	Unit	33 kV	Reference Doc
	- Auxiliary switch			
	- Rupturing current at 110 V DC	A		
	- Number of free NO contacts			
	- Number of free NC contacts			
	- Test voltage 50Hz, 1 min.	V		
	Manufacturer's of:			
	- Support insulators			
	- Breaker insulators			
	- Operating mechanism			
	NOTE			
	- In addition to the characteristics listed above, the following information shall be given for all switchgear:			
	- Layout and overall dimensions drawings			
	- descriptions			
b.3	**Earthing Switches**			
	- Reference standard			
	- Type of isolating switch			
	- Min. creepage distance (live parts to earth)	mm		
	- Min. isolating distance (clearance between open contacts)	mm		
	- Material of contact surface			
	- Total contact pressure			
	- Type of operating device			
	- weight of earthing switch			
b.4	**Current Transformers**			
	- Reference standard			
	- Type designation			
	- Overall dimensions			
	- Total weight of one current transformer	kg		
	- Type of insulation			
b.5	**Voltage transformers**			
	- Reference standard			
	- Type designation			
	- Overall dimensions			
	- Total weight of one current transformer	kg		
	- Type of insulation			
	- Type of insulation			

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

Sheet 1 of 6

MV INDOOR SWITCHGEAR			33kv	11 kV	
Item	Particulars	Unit	Guar. Fig	Guar. Fig.	Reference Doc
a.1	**Cubicles**				
	Manufacturer				
	Metal Clad type				
	- Rated Voltage	kV			
	- Maximum service voltage	kV			
	- Rated frequency	Hz			
	- Rated continuous busbar current	A			
	- One minute power frequency withstand voltage, dry and wet				
	- to earth	kV rms			
	- Impulse withstand voltage 1.2/50 ms				
	- to earth	kV peak			
	- Permissible 1 second short-time current	kA rms			
	- Dynamic short-time current	kA peak			
	Arch tested in accordance with IEC 60280 amendment 2	Yes/no			
a.2	**Circuit Breakers** (Type _____)				
	Breaking Medium	SF_6/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-2a TECHNICAL GUARANTEES, MV INDOOR SWITCHGEAR Sheet 2 of 6

MV INDOOR SWITCHGEAR			33KV	11 kV	
Item	Particulars	Unit	Guar. Fig	Guar. Fig	Reference Doc
	Circuit breakers continued				
	- Overvoltage factor for disconnection of unloaded transformers (without voltage limitation by lightning arresters)				
	- Rated inductive current switching capacity	A			
	- Permissible 1 second short-time current	kA rms			
	- Dynamic short-time current	kA peak			
	- 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	m.sec.			
	- Make time, interval of time between the initiation of closing operation and the instant when the current begins to flow in the main circuit	m.sec.			
	- Total break time, interval of time between the instant of application of tripping impulse to the instant of final arc extinction in all poles				
	- at 100% breaking capacity	m.sec.			
	- under phase opposition	m.sec.			
	- Rate of rise of recovery voltage (RRRV) at 100% short circuit current				
	- 3-phase	kV/msec			
	- 1-phase				
	- RRRV out of phase duty	kV/msec			
	- Minimum temperature rise at rated current of main contact	°C			
a.3	**Earthing Switches**				
	- Rated short-time current 1 sec.	kA rms			
	- Rated dynamic short-circuit current				
	- Making Capacity				

SCHEDULE VI-2a TECHNICAL GUARANTEES, MV INDOOR SWITCHGEAR

Sheet 3 of 6

MV INDOOR SWITCHGEAR				11 kV	
Item	Particulars	Unit		Guar. Fig	Reference Doc
a.4	**Current Transformers**				
	Manufacturer				
	- Rated voltage	kV			
	- Maximum service voltage	kV			
	- Rated frequency	Hz			
	- One-minute power frequency test voltage of				
	- primary winding	kV rms			
	- secondary winding	kV rms			
	- Lightning impulse withstand voltage	kV peak			
	- Rated primary currents	A			
	- Rated secondary current	A			
	- Short-time thermal rating				
	- 1 second	kA rms			
	- Short-time dynamic rating	kA peak			
	- Burden and accuracy class of				
	- measuring core				
	- protection core				
	- Instrument security factor of the measuring core				
	- Accuracy limit factor of the				
	- protection core				
a.5	**Voltage Transformers**, Type _____				
	Manufacturer				
	- Rated voltage	kV			
	- Maximum service voltage	kV rms			
	- One-minute power frequency test voltage				
	- primary winding	kV rms			
	- secondary winding	kV rms			
	- Lightning impulse withstand voltage	kV peak			
	- Burden and accuracy class of				
	a. measuring winding protection winding				
	- Ratio	kV			
a.6	**Country of Manufacture**				
	- Cubicles				
	- Circuit breakers				
	- Current transformers				
	- Voltage transformers				

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

SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR

Sheet 1 of 6

MV INDOOR SWITCHGEAR					
Item	Particulars	Unit		11 kV	Reference Doc
b.1	**Cubicles**				
	- Reference standard				
	- Type of conductors				
	- Conductor material				
	- Cross-section of busbars	mm^2			
	Cross section of branch off	mm^2			
	- Temperature rise of busbars at rated current	ºC			
	- Distances between				
	- - Busbar phases	mm			
	- - branch offs	mm			
	- - Live parts and earth	mm			
	- Are busbars insulated? If so state insulation material				
	- Class of protection	IP			
	- Short circuit test certificate designation				
	- Overall dimensions of the complete cubicle				
	- - length	mm			
	- - height	mm			
	- - width	mm			
	- Thickness of plates	mm			
	- Movement in isolator function	Hor./vert.			
	- Isolation distance	mm			
	- shutters when isolated or withdrawn?	Yes/no			
	- Weight of complete cubicle with circuit breaker etc.				
b.2	**Circuit Breakers**				
	- 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-2b INFORMATIVE DATA, MV INDOOR SWITCHGEAR Sheet 2 of 6

MV INDOOR SWITCHGEAR

Item	Particulars	Unit		11 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_6 breakers				
	- Normal gas density for SF6 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-2b INFORMATIVE DATA, MV INDOOR SWITCHGEAR Sheet 3 of 6

MV INDOOR SWITCHGEAR

Item	Particulars	Unit		11 kV	Reference Doc
	- Auxiliary switch				
	- Rupturing current at 110 V DC	A			
	- Number of free NO contacts				
	- Number of free NC contacts				
	- Test voltage 50Hz, 1 min.	V			
	Manufacturer's of:				
	- Support insulators				
	- Breaker insulators				
	- Operating mechanism				
	NOTE				
	- In addition to the characteristics listed above, the following information shall be given for all switchgear:				
	- Layout and overall dimensions drawings				
	- descriptions				
b.3	**Earthing Switches**				
	- Reference standard				
	- Type of isolating switch				
	- Min. creepage distance (live parts to earth)	mm			
	- Min. isolating distance (clearance between open contacts)	mm			
	- Material of contact surface				
	- Total contact pressure				
	- Type of operating device				
	- weight of earthing switch				
b.4	**Current Transformers**				
	- Reference standard				
	- Type designation				
	- Overall dimensions				
	- Total weight of one current transformer	kg			
	- Type of insulation				
b.5	**Voltage transformers**				
	- Reference standard				
	- Type designation				
	- Overall dimensions				
	- Total weight of one current transformer	kg			
	- Type of insulation				
	- Type of insulation				

SCHEDULE VI-2b INFORMATIVE DATA MV INDOOR VOLTAGE SWITCHGEAR

Sheet 4 of 6

MV INDOOR SWITCHGEAR					
Item	Particulars	Unit	66 kV		Reference Doc
b.1	**Cubicles**				
	- Reference standard				
	- Type of conductors				
	- Conductor material				
	- Cross-section of busbars	mm^2			
	Cross section of branch off	mm^2			
	- Temperature rise of busbars at rated current	ºC			
	- Distances between				
	- - Busbar phases	mm			
	- - branch offs	mm			
	- - Live parts and earth	mm			
	- Are busbars insulated? If so state insulation material				
	- Class of protection	IP			
	- Short circuit test certificate designation				
	- Overall dimensions of the complete cubicle				
	- - length	mm			
	- - height	mm			
	- - width	mm			
	- Thickness of plates	mm			
	- Movement in isolator function	Hor./vert.			
	- Isolation distance	mm			
	- shutters when isolated or withdrawn?	Yes/no			
	- Weight of complete cubicle with circuit breaker etc.				
b.2	**Circuit Breakers**				
	- 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-2b INFORMATIVE DATA, MV INDOOR SWITCHGEAR Sheet 5 of 6

MV INDOOR SWITCHGEAR

Item	Particulars	Unit	66 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_6 breakers				
	- Normal gas density for SF6 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-2b INFORMATIVE DATA, MV INDOOR SWITCHGEAR Sheet 6 of 6

MV INDOOR SWITCHGEAR

Item	Particulars	Unit	66 kV		Reference Doc
	- Auxiliary switch				
	- Rupturing current at 110 V DC	A			
	- Number of free NO contacts				
	- Number of free NC contacts				
	- Test voltage 50Hz, 1 min.	V			
	Manufacturer's of:				
	- Support insulators				
	- Breaker insulators				
	- Operating mechanism				
	NOTE				
	- In addition to the characteristics listed above, the following information shall be given for all switchgear:				
	- Layout and overall dimensions drawings				
	- descriptions				
b.3	**Earthing Switches**				
	- Reference standard				
	- Type of isolating switch				
	- Min. creepage distance (live parts to earth)	mm			
	- Min. isolating distance (clearance between open contacts)	mm			
	- Material of contact surface				
	- Total contact pressure				
	- Type of operating device				
	- weight of earthing switch				
b.4	**Current Transformers**				
	- Reference standard				
	- Type designation				
	- Overall dimensions				
	- Total weight of one current transformer	kg			
	- Type of insulation				
b.5	**Voltage transformers**				
	- Reference standard				
	- Type designation				
	- Overall dimensions				
	- Total weight of one current transformer	kg			
	- Type of insulation				
	- Type of insulation				

SCHEDULE VI 3a TECHNICAL GUARANTEES, CONTROL SYSTEM

Sheet 1 of 1

SUBSTATION CONTROL SYSTEM (SCS)			
Item	Particulars	Unit	Guar. Fig
a.1	**Control system response and update time under "moderate load" conditions**		
	The control system shall be designed to yield the following response and update times under "moderate load" conditions		
	- Time taken to completely refresh data held with the SCS:		
	a. maximum	s	
	b. average	s	
	- Time taken to carry out a complete status check of all indications and alarms		
	a. maximum	s	
	b. average	s	
	- The time between selection and display of a VDU diagram fully updated from the existing main computer data base shall not exceed	s	
	- The time between selection of a control function and check back shall not exceed	s	
	- The time between execution of a control function and successful completion being displayed at the Operation Workshop shall not exceed for		
	a. Circuit breaker (operating time = 250 ms)	s	
	b. Isolator (operating time = 10s)	s	
	- The time between the occurrence of the first change of state/alarm and display at the Operator Workstation shall not exceed	s	
	- The time between selecting display of analogue measurements and the corresponding value in the database being displayed shall not exceed	s	
	- The time between successive updates of the data base with analogue measurements shall not exceed	s	
	a. Network MW measurements	s	
	b. Other analogue measurements	s	
a.2	**Equipment Reliability**		
	Mean time between failure shall be not less that:		
	- Each computer	h	
	- VDU	h	
	- Logging printer	h	
	- System console	h	
	- Communication system	h	

SCHEDULE VI 3b INFORMATIVE DATA, CONTROL SYSTEM

Sheet 1 of 1

SUBSTATION CONTROL SYSTEM (SCS)			
Item	Description	Unit	Data
b.1	**General System Considerations** - Software - Package - Which RTU communication protocols are supported - Real-time database - Package - Is an SQL interface supported - Database Management Tool - Package - Is an SQL interface supported? - Man-machine Interface - Package - State type of man-machine interface software		
b.2	**Operator Workstation** - Reference standard - Type designation - Weight - Mounting arrangement VDU - Reference standard - Type designation - Diagonal screen size - Usable display area - Weight - Mounting arrangement Alphanumeric Keyboard - Reference standard - Type designation - Mounting arrangement	 kg mm max. mm kg	

SCHEDULE VI 4a TECHNICAL GUARANTEES, PROTECTION ETC.

Sheet 1 of 3

CONTROL, PROTECTION, METERING, SIGNALLING				
Item	Particulars	Unit	Guar. Fig	Reference Doc
a.1	**Indicating Instruments**			
	- 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:			
	- Instrument for: (A, V (AC), V (DC), W, etc.)			
	- Error	%		
	- Max. admissible current	%.I_N		
	- Max. admissible voltage	%.I_N		
a.2	**Meters**			
	- To be filled in for each meter			
	- Meter for (MWh, MVArh):			
	- Error with 5% load	%		
	- Error with 10% load	%		
	- Error with 20% load	%		
	- Error with 100% load	%		
	- Max. admissible current	%.I_N		
a.3	**Metering Converters (Transducers)**			
	- Converter for (MW, MVAr, A, etc):			
	- Error	%		
	- Linearity	%		
	- Max. admissible current for 0.5 seconds	%.I_N		
	- Max. admissible current continuously	%.I_N		
	- Max. admissible voltage for 0.5 seconds	%.I_N		
	- Max. admissible voltage continuously	%.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	**Protection Relays**			
	- To be **copied** and filled in for each type of relay as applicable			
	Relay for _____:			
	- Accuracy of the adjustable tripping time	sec.		
	- Min. possible tripping time	ms		
	- Drop out ratio	%		
	- Directional sensitivity (dist. relay only)	%.U_N		
	- Max. admissible current during 0.5 sec.	%.I_N		
	- Max. admissible current continuously	%.I_N		
	- Relation between tripping coil current and holding coil current (diff. relay only)	%		
	- Limit value of the adjustable tripping current (O.C.R.)	%.I_N		
	- Limit value of the instantaneous tripping current (O.C.R.)	%.I_N		
	- Limit value of the adjustable tripping voltage (O.V.R.)	%.I_N		
	- Limit value of the instantaneous tripping voltage (O.V.R.)	%.I_N		
	<u>Distance Protection</u> Shall incorporate the following features: • Ratings: AC Inputs: 110V, 1Amp (three phase). • Power Supply Voltage: 110VDC. (Universal power supply of 30-300VDC is preferred). • The relays shall be of Numeric design. • Impedance criteria. • Three zones phase –phase Protection. • Three zones phase –earth Protection • Additional Zone 4 Protection • Automatic Switch on to fault. • Independent settings for each zone. • Distance to fault measurement. • Display: On operation, the relay should display the faulted phase(s), time and zone of operation and distance to fault. • IDMT Three Phase/Over current & Earth fault Protection. • Fuse failure supervision. • Auto- reclose logic 1 and/or 3 phases. • Three pole tripping logic. • Disturbance and event records including software for disturbance analysis. • Fault record should be incorporated. • At least six (6) Binary inputs. • Mho/Quadrilateral characteristics. • Stability against Switching inrush	Shall incorporate all the features as listed		

	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. <u>Three phase numeric directional over current and earth fault relay</u> 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 (Vn=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 +/-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	**Protection Relays** - To be **copied** and filled in for each type of relay as			

	applicable			
	Relay for _____:			
	- Accuracy of the adjustable tripping time	sec.		
	- Min. possible tripping time	ms		
	- Drop out ratio	%		
	- Directional sensitivity (dist. relay only)	%.U_N		
	- Max. admissible current during 0.5 sec.	%.I_N		
	- Max. admissible current continuously	%.I_N		
	- Relation between tripping coil current and holding coil current (diff. relay only)	%		
	- Limit value of the adjustable tripping current (O.C.R.)	%.I_N		
	- Limit value of the instantaneous tripping current (O.C.R.)	%.I_N		
	- Limit value of the adjustable tripping voltage (O.V.R.)	%.I_N		
	- Limit value of the instantaneous tripping voltage (O.V.R.)	%.I_N		
	<u>Biased differential protection for a two winding transformer</u>. • Relay Must be of Numerical design • Pick up setting range, 0.1 to 0.5In • Should incorporate a high-set Element with a setting range of up to 20In. • Magnetising current inrush restraint • Integral CT ratio compensation (0.1-2) and vector group compensation • Measurement and indication on the MMI, of phase, differential and bias currents • Storage of Fault records and Event records; the Fault flags should be accessible on the relay LCD screen without opening the relay cover. • Overfluxing restraint • Overfluxing protection with Alarm and Trip functions • 5th harmonic restraint feature on the differential Element. • Appropriate Dual Bias characteristic to ensure relay stability for heavy through faults • Should incorporate a disturbance recorder feature. • Red L.E.D to indicate Tripping • Relay Self diagnostic and Alarm feature • Ability to Latch output contacts to prevent TX re-energizing before carrying out investigations. <u>Three phase numeric IDMTL over current and earth fault relay</u> Should incorporate the following Features;	Shall incorporate all the features as listed		

	• Relay must be of Numerical Type • Current setting range for over current relay 0.5In-2.4In • Current setting range for earth fault relay 0.05In-0.8In • I.D.M.T characteristics according to BS142 or IEC 60255 i.e. SI,VI,EI,LTI, including definite time for the high-set Elements. • 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 • Fault records, Event Records and disturbance records. • Configurable output relays with ability to output starting elements to control Tripping of other upstream Protection relays. • Drop off /pickup ratio >90% • Low transient overreach < 10%	Shall incorporate all the features as listed		
	<u>Restricted Earth fault relay</u> • Relay must be of Numerical type • Relay should reject harmonics produced by C.T saturation • The offer should include the associated stabilising resistor and voltage dependent resistor (metrosil) • Current setting range 0.05-0.8In • Operating time < 25ms at 5 times the setting	Shall incorporate all the features as listed		

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

CONTROL, PROTECTION, METERING, SIGNALLING

Item	Particulars	Unit	Guar. Fig	Reference Doc
a.5	**Auxiliary Circuit Breakers**			
	- To be filled in for each type of AC and DC breaker:			
	- Min. operating voltage	$\%.U_N$		
	- Max. operating voltage	$\%.U_N$		
	- Drop out voltage	V		
	- Service life (min. number of contact operation)			
a.6	**Manufacturer's Name**			
	- Control room boards			
	- Local relay boards			
	- Protection relays			
	- Auxiliary contactors			
a.7	**Country of Manufacture**			
	- 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	**Indicating Instruments**			
	To be filled in for each type of instrument:			
	- Reference standard			
	- Type (moving coil, iron type, etc.)			
	- Consumption of internal resistance	VA/ohm		
	- Size	mm		
b.2	**Meters**			
	To be filled in for each type of meter:			
	- Reference standard			
	- Type			
	- Consumption of internal resistance	VA/ohm		
	- Size	mm		
b.3	**Metering Converters** (Transducers)			
	To be filled in for each type for converter:			
	- Reference standard			
	- Type			
	- Consumption, current	VA		
	- Consumption, voltage	VA		
	- Time constant	ms		
	- Size	mm		
b.4	**Alarm Annunciators**			
	To be filled in for each annunciator panel:			
	- Reference standard			
	- Type			
	- Number of annunciators			
	- Size of each annunciator (area of the cap)	mm		
	- Total size of panel	mm		
b.5	**Control Room Board**			
	- Height	mm		
	- Width	mm		
	- Length	mm		
	- Relay boards			
	- Height			
	- Width			
	- Length			

SCHEDULE VI 4b INFORMATIVE DATA, PROTECTION ETC. Sheet 2 of 2

CONTROL, PROTECTION, METERING, SIGNALLING

Item	Particulars	Unit	Data	Reference Doc
b.6	**Protection Relays** To be **copied** and filled in for each relay with the applicable items of the data below: Relay for _____: - Reference standard - Consumption - Limit values of the adjustable tripping time - Limit values of the adjustable sensitivity - Limit values of the adjustable operating quantity (current, voltage, frequency, etc.) in % of normal - Limit values of the instantaneous operating quintet in % of nominal value - Size For distance relay only: - Starting impedance adjustable between - Earth fault tripping current adjustable between	 VA sec. % % % mm ohm/ph $x.I_N$		
b.6	**Protection Relays** To be filled in for each relay with the applicable items of the data below: Relay for _____: - Reference standard - Consumption - Limit values of the adjustable tripping time - Limit values of the adjustable sensitivity - Limit values of the adjustable operating quantity (current, voltage, frequency, etc.) in % of normal - Limit values of the instantaneous operating quintet in % of nominal value - Size For distance relay only: - Starting impedance adjustable between - Earth fault tripping current adjustable between	 VA sec. % % % mm ohm/ph $x.I_N$		

SCHEDULE VI 5b INFORMATIVE DATA, CABLES

Sheet 1 of 2

POWER CABLES, CONTROL CABLES, CABLE RACKS				
Item	Particulars	Unit	Data	Reference Doc
b.1	Low Voltage Cables			
	- Conductor material			
	- Insulation material			
	- Armouring/screen			
	- Protective coating			
	- Overall diameter of cable of biggest cable	mm		
	- Weight of heaviest reel, including cable	kg		
	- Size of biggest reel, diameter/width	mm/mm		
b.2	**Control and Measuring Cables**			
	- Conductor material			
	- Insulation material			
	- Armouring/screen			
	- Protective coating			
	- Overall diameter of cable of biggest cable	mm		
	- Weight of heaviest reel, including cable	kg		
	- Size of biggest reel, diameter/width	mm/mm		
b.3	**Special Cables**			
	To be used for:			
	- Relevant informative data			

SCHEDULE VI 5b INFORMATIVE DATA, CABLES

Sheet 2 of 2

POWER CABLES, CONTROL CABLES, CABLE RACKS				
Item	Particulars	Unit	Data	Reference Doc
	11 kV Voltage Cables - 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		
	33 kV Voltage Cables - 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		
	66 kV Voltage Cables - 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		
	Special Cables, Optical fibre - Relevant informative data			

SCHEDULE VI 6a TECHNICAL GUARANTEES, EARTHING

Sheet 1 of 1

EARTHING SYSTEM				
Item	Particulars	Unit	Guar. Fig	Reference Doc
a.1	**Resistance to Earth of Earthing Electrode System** (for each substation)			
	- Under the control building max.	ohms		
	- Under the switchyard max.	ohms		
	- Complete earthing system	ohms		

SCHEDULE VI 6b INFORMATIVE DATA, EARTHING

Sheet 1 of 1

EARTHING SYSTEM				
Item	Particulars	Unit	Data	Reference Doc
b.1	- Reference standard - Material of earth conductor - Max. temp of any earth conductor during 1 sec. rated phase - ground fault - Method of interconnecting earth grid conductors			

TECHNICAL SCHEDULES TRANSFORMERS

SCHEDULE VI 7a - TECHNICAL GUARANTEES, POWER TRANSFORMERS

Sheet 1 of 7

HV POWER TRANSFORMERS			Guaranteed Data		
Item	**Description**	**Unit**	**7.5MVA**	**2.5MVA**	
1.	Continuous maximum rating on any tapping when operation under the ambient conditions specified in Section VI, Clause 4.1.3.2.1 Design criteria:				
	With ONAN cooling;				
	HV winding	MVA			
	LV winding	MVA			
	TV winding	MVA	-		
	With ONAF cooling;				
	HV winding	MVA			
	LV winding	MVA			
	TV winding	MVA	-		
2.	Rated frequency	Hz			
3.	Rated no-load voltage at rated frequency on:				
	HV, principal tapping	kV			
	HV, extreme plus tapping	kV			
	HV, extreme minus tapping	kV			
	LV,	kV			
	TV,	kV	-		
4.	Tapping ranges from principal tapping:				
	HV, no of plus tappings	-			
	HV, no of minus tappings	-			
	HV, steps in % of rated voltage	%			
5.	No-load losses at rated voltage and frequency	kW			
6.	No-load current at rated voltage and frequency	A			

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 75ºC 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 75ºC on principal tapping and unity power factor and rated currents:				
	ONAN	kW			
	ONAF including input to cooling plant	kW			
10.	Impedance voltages at 75º 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**	**23MVA**
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	kV			
	- LV	kV			
	- TV	kV	-		
25.	Maximum flux density at rated voltage on principal tapping and rated frequency:				
	- Transformer legs	T			
	- Transformer yokes	T			
26.	Maximum flux density at most onerous voltage and frequency conditions:				
	- Transformer legs	T			
	- Transformer yokes	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^2			
	HV, lower voltage, ONAF	A/mm^2			
	LV, ONAN	A/mm^2			
	LV, ONAF	A/mm^2			
	TV, ONAN	A/mm^2			
	TV, ONAF	A/mm^2			
29.	Magnetising current at rated nominal voltage on principal tapping	A			
30.	Maximum hot spot temperature of winding	^oC			
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**	**23MVA**
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^3			
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

HV POWER TRANSFORMERS					
Item	**Description**	**Unit**	**7.5MVA**	**2.5MVA**	**23MVA**
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**	**23MVA**
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**	**23MVA**
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^3/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**	**23MVA**
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**	**7.5**	**2.5MVA**	**23MVA**
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

HV POWER TRANSFORMERS					
Item	**Description**	**Unit**	**7.5**	**2.5MVA**	**23MVA**
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**	**23MVA**
59.	State all Standards applied underneath:				
60.	State identity of transformer manufacturer and all sub-manufacturers including the parts manufactured below: Transformer: Cooling equipment On-load tap changer Current transformers Bushings Core steel Oil Buchholz relay Breather Thermometer Other equipment to be listed by the Bidder: - - - - -				

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	ºC		
	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**		**33/0.415 kV**
5.	Type of insulation used on windings			
	a) H.V.			
	b) L.V.			
6.	Lightning Impulse Insulation level of:			
	a) H.V. winding	kVpk		
	b) L.V. winding	kVpk		
	c) Tap change equipment and connections			
	i) To earth	kVpk		
	ii) Between contacts	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**		**33/0.415 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^3		
10.	Type of bushings HV LV			

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

DISTRIBUTION TRANSFORMER				
Item	**Particulars**	**Unit**		**33/0.415 kV**
11.	Bushing insulator material			
	HV			
	LV			
12.	Creepage distance across bushings			
	HV	mm		
	LV	mm		
13.	Type of cooling system			
14.	Total oil quantity	k		
15.	Total weight			
16.	Volume of conservator tank	l		
17.	Overall dimensions			
	Length	mm		
	Width	mm		
	Height	mm		
18.	State all standards applied underneath:			
19.	State identity of manufacturer underneath:			

SCHEDULE VI-9a- GAURANTEE DATA TELECOMMUNICATION SYSTE

Fiber optic cable

Particulars	Unit	Employer's requirement	Tender value
Number of fibres	OPGW	≥ 48	
	ADSS	≥ 48	
Core diameter	µm	8.3 or 9 with a 3% tolerance	
Cladding design, either matched or depressed			
Clad diameter	µm	125.0 ± 2	
Core-clad concentricity		< 2%	
Coating diameter	µm	250.0 ± 15	
Coating concentricity	≥	0.70	
Attenuation: 1310 nm 1550 nm	dB/km	≤ 0.40 ≤ 0.25	
Bending attenuation: 1310 nm 1550 nm	dB/km	≤ 0.40 ≤ 0.25	
Temperature dependence	dB/km	≤0.05 (-20°C-+85°C)	
Cut-off wavelength	nm	≤ 1250	
Chromatic dispersion:			
Zero dispersion at	nm	1310 ± 12 1550 ± 15	
Zero dispersion slope (max.)	ps/nm^2 (km)	0.092 0.085	
Mode field diameter:			
1300 nm	mm	9.30 ± 0.50	
1550 nm	mm	10.50 ± 1.00	
IL-proof test level	g/m2	35 x 106	
Splice attenuation	dB/ splice	0.02	
Connector loss	dB/connect or	< 0.5	
ODF			
Manufacturer	-		
Type	-		
Number of fiber interconnections	-	96 48	
Connector loss	dB/connect or	< 0.5	
Screw on type connectors	-	yes	
designed for 19” cubicles	-	yes	

SCHEDULE VI-9e- Guaranteed Technical specifications SDH Multiplexer and Access Multiplexer

Particulars	Unit	Employer's requirement	Tender value
General			
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.	-		
Construction Requirements			
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.			
Optical Parameters			
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.			
Transmission Parameters			
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)			