

PART 2: EMPLOYER'S REQUIREMENTS
CHAPTER 9B: TRACTION NETWORK-
TECHNICAL SHEETS

TABLE OF CONTENTS

1.	TECHNICAL SHEETS	3
1.1.	25 kV CIRCUIT BREAKER	3
1.2.	25kV INTERRUPTERS.....	4
1.3.	25 kV ISOLATORS (MANUAL OR MOTORISED, POLE MOUNTED)	5
1.4.	25kV CURRENT TRANSFORMER	6
1.5.	25 kV LIGHTNING ARRESTER.....	7
1.6.	25kV VOLTAGE TRANSFORMER.....	8
1.7.	25kV CAPACITIVE VOLTAGE SENSOR	9
1.8.	25 kV CABLES.....	9
1.9.	3.3 kV CABLES	11
1.10.	SPRING TYPE ATD	12

Note: These specifications are the bare minimum requirement, PST Contractor must verify the design and should fulfil system requirements while selecting system/equipment/component & executions. The final requirements of the specifications will depend upon the simulation studies and based upon that the PST contractor has to provide the material over and above to these specifications which shall be finally approved by Engineer / Employer. However, payment for any extra material requirements over and above to these specifications, if needed, and not covered in the BoQ shall be governed by clause no. 13.3.3(B)2 of section-IX PCC.

1. TECHNICAL SHEETS

1.1. 25 kV Circuit Breaker

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 62271-1, IEC 62271-100 & RDSO TI/SPC/LVCBIN/0120
Type		Vacuum
Erection		Outdoor
Nominal System Voltage (Phase to Neutral) U_n	kV _{rms}	27.5
Rated Frequency	Hz	50 +/- 3%
Number of Phases		1
Type of Mechanism		Magnetic Actuator / Toggle Spring
Rated Insulation Voltage level	kV	52
Rated operating current	A _{rms}	1250 / 1600
Rated short time withstand current	kA/sec	20 kA / 3 sec
Rated Power frequency withstand voltage for one minute	kV rms	95
Rated impulse with-stand (1.2/50 μ s) voltage for Primary winding	kV peak	250
Creepage Distance	mm	1600 (min.)
Rated Short circuit making capacity	kA peak	50
Rated Short circuit breaking capacity	kA	20/ 3 sec
Rated Operating Sequence		0-0.3sec-CO-15sec-CO
Rated Line charging current	A rms	10
Rated peak withstand current	kA peak	50
Mechanical life cycle	Number of Operations	10,000 for Spring type 20,000 for Magnetic Actuated type
With Vacuum bottle	Number of operations	20,000 (for both types)

Electrical lifetime		10,000 x 1250, 100x20kA
Maximum closing time	ms	75 + <u>15</u>
Maximum opening time	ms	45 + <u>15</u>

Insulation material		Porcelain
Motor Power	W	250 (for spring charge)
Motor service voltage	Vdc	110
Auxiliaries contacts		8NO + 8NC
Ambient temperature range	°C	-1 to +50
Degree of Protection		IP 55

Table 1 Technical Sheet of 25kV Circuit Breaker**1.2. 25kV Interrupters**

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60694, IEC 62271-100, IEC 62271-1, RDSO Spec TI/SPC/LVCBIN/0120
Type		Vacuum
Erection		Outdoor
Nominal System Voltage (Phase to Neutral) U_n	kV _{rms}	27.5
Rated Voltage, U_r	kV _{rms}	52
Rated Frequency	Hz	50 +/- 3%
Number of Phases		1
Type of Mechanism		Magnetic Actuator / Toggle Spring
Nominal System Voltage	kV	25
Rated Insulation Voltage level	kV	52
Rated operating current	A	1600
Rated short time withstand current	KA/sec	20KA/3 Sec
Rated Power frequency withstand voltage for one minute	kV rms	95
Rated impulse with-stand (1.2/50µs) voltage for Primary winding	kV peak	250
Creepage Distance	mm	1600 (min.)
Rated Short circuit breaking capacity	kA	20
Rated Line Charging breaking current	A rms	10
Rated Making Current	kA peak	50
Rated Peak withstand Current	kA peak	50
Rated operating sequence		CO-15sec-CO
Mechanical life cycle	Number of Operations	10,000 for Spring type 20,000 for Magnetic Actuated type
With Vacuum bottle	Number of operations	20,000 (for both types)
Electrical lifetime		10,000 x 1250, 100x20kA

Maximum closing time	ms	75 + 15
Maximum opening time	ms	45 + 15
Insulation material		Composite/Ceramic
Motor Power	W	250 (for spring charge)
Motor service voltage	Vdc	110
Auxiliaries contacts		8NO + 8NC
Ambient temperature range	°C	-1 to +50
Degree of Protection		IP 55

Table 2 Technical Sheet of 25 kV Interrupters

1.3. 25 kV Isolators (Manual or Motorised, Pole Mounted)

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		RDSO Spec TI/SPC/PSI/ISOLTR/0210 (07/2021) or Latest, IS 2071-1, IEC 60060-1, IEC 62271-200, EN 50163 & IEC 60850
Erection		Outdoor
Rated Voltage	kV	27.5
Rated Frequency	Hz	50
Poles		1 or 2 as required
Nominal System Voltage	kV	25
Rated Insulation Voltage level	kV	52
Rated operating current	A	1600
Rated short time withstand current	kA / sec	20kA / 3 sec
Rated peak with stand current	KA peak	50kA for 3 sec
Creepage Distance	mm	1600 (min.)
Rated Power frequency withstand voltage for one minute To Earth & Poles	kV rms	95
Rated impulse with-stand (1.2/50 μ s) voltage for Primary winding To Earth and Poles	kV peak	250
Opening / Closing mode		Motorized / Manual
Operating time		8.5 s
Auxiliary supply control voltage	Vdc	110
Auxiliary contacts		8NO + 8NC
Mechanical lifetime	Cycles	10,000
Ambient temperature range	°C	-1 to +50
Degree of Protection for operating Box		IP 65

Table 3 Technical Sheets of 25 kV Isolators

1.4. 25kV Current Transformer

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 61869-1, IEC 61869-2, IEC 60850, EN 50163, RDSO TI/SPC/PSI/CT/0210(07/2021)
Erection		Outdoor
Rated Voltage	kV	27.5
Rated Frequency	Hz	50
Transformer Type		Cast resin
Number of Phases		1
Highest Voltage of the equipment (U_m) Phase to Neutral	kV rms	30
Highest Voltage of System (U_{sys}) Phase to Neutral	kV rms	30
Rated Primary (Phase-Neutral) Voltage of 25 kV CT	kV	27.5
Rated basic insulation level	KV	52 kV
Rated Power frequency withstand voltage one minute for primary winding	kV rms	95
Rated impulse with-stand (1.2/50 μ s) voltage for Primary winding	kV peak	250
Rated Secondary current	A	1
Rated Short-time thermal current for 1 sec	kA	25
Rated dynamic current	kA peak	62.5
Rated continuous thermal current	A	120% of rated primary current
Creepage Distance	mm	1600 (min.) / or 31 mm / kV
Secondary core, CT between Transformer and 25 kV breaker side		
Core 1 (Protection)		1600-800/1A, 5P10, 10- 20VA Protection class
Core 2 (Protection)		1600- 800/1A, 5P10, 10VA -20 VA Protection class
Core -3		400-800 1 A, 10 VA CL 0.5
Withstand overcurrent (3s / peak)	kA	20 / 50
Ambient temperature range	°C	-1 to +50
Degree of Protection		IP 55

Table 4 Technical Sheet of 25 kV Current Transformer

1.5. 25 kV Lightning Arrester

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60099-4, IEC 60089-5, RDSO Spec. ETI/PSI/71 (1/87) with A&C, Latest Version
Type of substation		Outdoor
Lightning arrester type		Non-linear metal oxide resistor type, gapless
Arrester housing		Polymeric
Creepage distance	mm	1600 (min.)
Nominal Voltage (Phase to Earth), U_n	kV rms	27.5
Possible variation in traction supply voltage	kV	19 to 27.5 kV, short duration reaching 30kV
Temporary Overvoltage TOV	kV rms	38.75
Rated voltage U_r	kV	42
Rated Frequency	Hz	50
Continuous operating voltage	kV	35
Line discharge class	Cl	Cl-3
Nominal discharge current	kA	20
Maximum residual voltage for discharge current of (8/20 micro sec wave) 1. 10KA 2. 20 KA 3. 40 KA		109 KV Peak 117 KV Peak 132 KV Peak
Max Steep Front Residual voltage at 20 kA with one micro sec rise time		135 kV peak
Max switching impulse residual voltage with 40/80 micro sec wave at 2 kA		88 KV Peak
Energy dissipation capability		13.5 KJ/KV
Short circuit current capability		40 KA r,ms
Power frequency with-stand voltage for arrester housing	kV	105
Pressure relief class		A
Ambient temperature range	°C	-1 to +50
Table 5 Technical Sheet of 25 kV Lightning Arrester		

1.6. 25kV Voltage Transformer

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 61869-1, IEC 61869-3, EN 50152-3-3, IEC 60850, EN 50163, RDSO TI/SPC/PSI/PT/0210/JUNE2021 or latest.
Erection		Outdoor
Type		Cast resin
Nominal Voltage Un	kV rms	27.5
Rated Frequency	Hz	50
Number of Phases		1
Highest Voltage of the equipment Um Phase to Neutral	kV rms	30
Highest Voltage of System (U_{sys}) Phase to Neutral	kV rms	30
Rated Insulation Voltage level	kV	52
Rated Power frequency withstand voltage one minute for primary winding	kV rms	95
Rated impulse with-stand (1.2/50 μ s) voltage for Primary winding	kV peak	250
Rated Primary/Secondary voltage	Voltage	27.5kV/110V
Creepage Distance	mm	1600 (min.)
Resistance of Primary winding	Ω	Not < 50000 Ω at 10°C *
Secondary core winding	Core-1 Core-2	27.5kV/110V
Precision Power	VA	30 at PF 0.8 lagging
Accuracy class for protection	Cl	Cl-1 (for indication purpose)
Ambient temperature range	°C	-1 to +50
Accuracy class for Protection		3P
Degree of Protection		IP 55

Table 6 Technical Sheet of 25 kV Voltage Transformer

*** for PT's connected between OHE and earth (Line Indication type)**

1.7. 25kV Capacitive Voltage Sensor

Particulars / Description	Unit	Data/Values Required
Sensor data		
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 61869-5
Erection		Outdoor
Type		Cast resin
Nominal Voltage Un	kV rms	27.5
Rated Frequency	Hz	50
Number of Phases		1
Rated Insulation Voltage level	kV	52
Rated Power frequency withstand voltage one minute for primary winding	kV rms	95
Rated impulse with-stand (1.2/50 μ s) voltage for Primary winding	kV peak	250
Sensor Capacity	pF	40
Operation		Continuous
Response time	S	< 0.2
Type of Measurement		RMS precision of 3 %
Current Loop converter		
Supply Voltage	V ac	230 +/- 20%, 85-265 VAC, 86-370 VDC
Output	mA	4-20
Consumption	W	2
Input / Output	VDC / mA	0-100 / 4-20
Linear	%	1
Precision	%	2
Response time	S	0.2
Output limit	mA	24

1.8. 25 kV Cables

Particulars / Description	Unit	Data/Values Required	
Manufacturer			
Place of manufacture			
Port of embarkation			
Manufacturer drawing reference			
Cable Size	Sq.mm	1C x 400	1C X 240

Cable Type		Aluminium / XLPE	Copper / XLPE
Standards		IEC 60840, IEC 60228, IEC-60502-2	
Voltage Grade	kV	26/45 (52)	
Operating Voltage	kV	27.5	
Shape of conductor		Stranded compacted circular	
Conductor Material		Class 2 / IEC 60228	
Conductor and Insulation Screen Materials		Extruded Semi-conducting	
Nom. Thickness of conductor screen	mm	0.7	
Insulation Material		XLPE	
Nom. Thickness of Insulation	mm	10	
Nom. Thickness of Insulation Screen	mm	0.8	
Conductor screen, insulation and insulation screen shall be extruded in a single process			
Insulating Screen Material (Metallic)	mm	Aluminium round wires followed by helically applied Aluminium Tape. Metallic screen should be able to withstand specified earth fault current (min. 14 kA for 3 sec.)	Copper round wires followed by helically applied Copper Tape. Metallic screen should be able to withstand specified earth fault current (min. 14 kA for 3 sec.)
Polyethylene laminated Aluminium Tape	mm	*	*
Inner Sheath Material		FRLS for ELEVATED & FRLSZH for UNDER GROUND	
Min. Thickness of extruded inner sheath	mm	1	1
Armouring		Double layer of Al tape (nominal thickness of each type-0.5 mm)	
Outer Sheath		FRLS for EL & FRLSZH for UG	
Min. Thickness of outer sheath	mm	3.5	3.5
Minimum Bending Radius	m	*	*
Max. Conductor Temp. (Continuous)	° C	90	90
Max. Conductor Temp. (Short Circuit)	° C	250	250
Min. Short Circuit Current Rating		14 kA for 3 sec	14 kA for 3 sec
Nominal diameter of conductor	mm	*	*
Nominal Overall diameter of cable	mm	*	*
No. and Diameter of wires	No./mm	*	*
Cross Section area of metallic screen	Sq.mm	*	*

Approximate weight of cable	Kg/km	*	*
Nominal Thickness of Tape	mm	*	*
Max. Rdc of conductor at 20°C	Ω/km	*	*
Max. capacitance of cable	$\mu\text{F}/\text{km}$	*	*
Max. current rating in air	A	*	*
Max. current rating in ground	A	*	*
Charging current, 50 Hz	A/Km	*	*
Max. Pulling force for laying		*	*
Length shall be marked with number at one-meter intervals on the sheath.			

Table 7 Technical Sheet of 25kV Cables

* PST Contractor to furnish the data at the time of Vendor Approval Stage.

1.9. 3.3 kV Cables

Particulars / Description	Unit	Data/Values Required
Manufacturer		
Place of manufacture		
Port of embarkation		
Manufacturer drawing reference		
Standards		IEC 60502-1, IEC 60228
Voltage Grade	kV	1.9/3.3 (3.6)
Operating Voltage	kV	3.3
Conductor		1C x 400 sq.mm
Conductor Material		Aluminium as per IEC 60228
Flexibility class as per IEC 60228		Class 2
Shape of conductor		Stranded compacted circular
Insulation Material		XLPE
Material		Extruded semi-conducting compound
Nominal thickness of extruded layer	mm	2
A semiconducting tape applied over insulation (Water Barrier)		Yes
Armouring		Double layer of Al tape with binder tape (FRLS/FRLSZH)
Outer Sheath		FRLS for EL & FRLSZH for UG
Min. Thickness of outer sheath	mm	2
Minimum Bending Radius	m	*
Max. Conductor Temp. (Continuous)	° C	90
Max. Conductor Temp. (Short Circuit)	° C	250

Min. Short Circuit Current Rating		14 kA for 3 sec
Nominal diameter of conductor	mm	*
Nominal Overall diameter of cable	mm	*
No. and Diameter of wires	No./mm	*
Approximate weight of cable	Kg/km	*
Max. Rdc of conductor at 20°C	Ω /km	*
Max. capacitance of cable	μ F/km	*
Max. current rating in air	A	*
Max. current rating in ground	A	*
Charging current, 50 Hz	A/Km	*
Max. Pulling force for laying		*
Length shall be marked with number at one-meter intervals on the sheath.		

Table 8 Technical Sheet of 3.3kV Cables

* PST Contractor to furnish the data at the time of Vendor Approval Stage.

1.10. SPRING TYPE ATD

The minimum mechanical characteristics of Spring pulley ATD are given below. The spring type ATD shall be used in main line as per Contract. The model of Spring type ATD shall be based on the stroke selected as per tension length. The Spring type ATD system can use linear spring or coil spring type design. The system shall be proven one in service.

Particulars / Description	Unit	Data/Values Required
Temperature Range	°C	-1 to 65
Environmental condition	-	Heavy Air Pollution.
Basic Wind Speed	m/s	33
OHE Design Speed	Kmph	90
Contact Wire	-	Cu-Ag 0.1 – 150 sq.mm
Catenary wire	-	C-Mg Bz-II, 120 sq.mm
Tension in Ohe	Kgf	3000
Half Tension length	M	700
Manufacturer Place of Manufacture Drawing reference number	-	To be shared by OEM

Table 8 Technical Sheet of Spring ATD