

Table: Technical Data for Distribution Transformer 315 kVA, 20/0.4 kV

Designation	Unit	Required	Offered
Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
Installation		With conservator	
Dielectric		outdoor	
Oil type		oil, without PCB	
Rated frequency	Hz	to be specified	
Rated power	kVA	50	
Number of phases		315	
Rated voltage:		3	
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	±2x2.5%, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	4	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding:			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding:			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

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Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material		Copper	
Insulating material of windings		to be specified	
Insulation class		yes	
Standard bushings			
Accessories:			
- Dial type contactor thermometer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard		IEC 60076-7 IEC 60354	

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Table: Technical Data for Distribution Transformer 250 kVA, 20/0.4 kV

Manufacturer's Name			
Type / Model			
Installation			To be specified
Dielectric			Oil-immersed
Oil type			With oil conservator
Rated frequency			outdoor
Rated power	Hz		oil, without PCB
Number of phases	kVA		to be specified
Rated voltage:			50
- High voltage side			250
- Low voltage side	kV		3
Taps on HV side	kV		20
Rated currents	%		0.4
- High voltage side			±2x2.5%, off load
- Low voltage side	A		
Impedance voltage	A		to be specified
Vector group	%		to be specified
Treatment of neutral (LV side)			4
Losses:			Dyn5
- No-load	W		Solidly earthed
- Load	W		
Insulation level HV-winding			To be specified
Lightning-impulse test voltage	kV		To be specified
Power-frequency test voltage	kV		125
Insulation level LV-winding			50
Lightning-impulse test voltage	kV		
Power-frequency test voltage	kV		30
			10

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Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material		Copper	
Insulating material of windings		to be specified	
Insulation class		yes	
Standard bushings			
Accessories:			
- Dial type contactor thermometer transformer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard specifications		IEC 60076-7	
		IEC 60354	

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Table: Technical Data for Distribution Transformer 200 kVA, 20/0.4 kV

Designation	Unit	Required	Offered
Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
Installation		With conservator	
Dielectric		outdoor	
Oil type		oil, without PCB	
Rated frequency	Hz	to be specified	
Rated power	kVA	50	
Number of phases		200	
Rated voltage:		3	
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	±2x2.5%, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	4	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding:			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding:			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

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Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material		Copper	
Insulating material of windings		to be specified	
Insulation class		yes	
Standard bushings			
Accessories:			
- Dial type contactor thermometer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard		IEC 60076-7	
		IEC 60354	

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Table: Technical Data for Distribution Transformer 100 kVA, 20/0.4 kV

Designation	Unit	Required	Offered
Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
Installation		With conservator	
Dielectric		outdoor	
Oil type		oil, without PCB	
Rated frequency	Hz	to be specified	
Rated power	kVA	50	
Number of phases		100	
Rated voltage:		3	
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	±2x2.5%, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	4	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding:			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding:			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

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Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material			
Insulating material of windings		Copper	
Insulation class		to be specified	
Standard bushings		yes	
Accessories:			
- Dial type contactor thermometer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard		IEC 60076-7 IEC 60354	

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Table: Technical Data for Distribution Transformer 50 kVA, 20/0.4 kV

Designation	Unit	Required	Offered
Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
Installation		With conservator	
Dielectric		outdoor	
Oil type		oil, without PCB	
Rated frequency	Hz	to be specified	
Rated power	kVA	50	
Number of phases		50	
Rated voltage:		3	
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	$\pm 2 \times 2.5\%$, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	4	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding:			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding:			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

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Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material			
Insulating material of windings		Copper	
Insulation class		to be specified	
Standard bushings		yes	
Accessories:			
- Dial type contactor thermometer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard		IEC 60076-7 IEC 60354	

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Table: Surge Arrester

Designation	Unit	Required	Offered
Manufacturer	-	-	
Country of origin	-		
Type	-	station metal oxide gapless	
Housing	-	silicon rubber	
Color	-	grey	
Nominal characteristics	-		
Rated max. network operating voltage	kV	24	
Rated operating voltage (Ur)	kV	24	
Rated continuous operating voltage (Uc)	kV	20	
Rated discharge current (peak)	kA	10	
Switching impulse current (peak)	kA	2	
Line discharge class (IEC 99-4)	-		
Rated frequency	Hz	50	
Protection characteristics			
Max. residual voltages			
- For a steep impulse current, 1/2 µs front, 10 kA.	kV	71	
- For lightning impulse current, 8/20 µs, 10 kA.	kV	67	
- For a switching impulse current 30/60 µs, 0.5 kA	kV	52	
Energy absorbing capacity	kJ/kV	4.3	
Operating performances			
High current impulse withstand (4/10 µs)	kA	100	
Temporary over voltage withstand (for 10s)	kV	24	

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Table: Surge Arrester

Designation	Unit	Required	Offered
Insulation levels			
- Lightning impulse withstand voltage	kV	125	
- Power frequency withstand voltage (1 m wet)	kV	50	
- Creepage distance	mm/kV	25	
- Cantilever strength	kN	-	
- Torsion strength	N-m	-	
Pressure relief capacity			
- Current amplitude (rms)	KA	17.5	
- X/R, asymmetry factor	-	17	
- Current duration	s	0.2	
Weights and dimensions:			
- Arrester height	mm	-	
- Arrester diameter	mm	-	
- Weight	kg	-	
Accessories			
Mounting hardware	-	Yes	
Ground Connector	-	Yes	
Insulating bases	-	Yes	
Discharge counter	-	-	
HV terminals connectors	-	Yes	
Standards	-	IEC 60099-4	
Quality control	-	ISO 9001	
Installation	-	Outdoor	

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Table: Technical Data Disconnecting Switch Combination fuse 20kV, 630 A

Description	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type / Model		to be specified	
Installation		pole mounted	
Nominal Voltage	kV	20	
Rated Voltage	kV	24	
Rated Frequency	Hz	50	
Rated Normal Current	A	630	
Rated Breaking current			
Rated lightning-impulse withstand voltage	kV	125	
Power frequency test voltage	kV	50	
Rated short-time current	kA	25	
Rated short-circuit making current	kA	63	
Creepage distance for insulators	mm/kV	25	
Distance between phase centers (min)	mm	350	
Link Fuse	A	To be specified according to BOQ	
Operation mechanism		Manual	
All necessary accessories		to be confirmed	
Standard specifications		IEC 60129 VDE 0670	

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Table: Technical Data Disconnecting Switch 20kV, 630 A

Description	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type / Model		to be specified	
Installation		pole mounted	
Nominal Voltage	kV	20	
Rated Voltage	kV	24	
Rated Frequency	Hz	50	
Rated Normal Current	A	630	
Rated Breaking current			
Rated lightning-impulse withstand voltage	kV	125	
Power frequency test voltage	kV	50	
Rated short-time current	kA	25	
Rated short-circuit making current	kA	63	
Creepage distance for insulators	mm/kV	25	
Distance between phase centers (min)	mm	350	
Operation mechanism		Manual	
All necessary accessories		to be confirmed	
Standard specifications		IEC 60129 VDE 0670	

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Table: Technical Data for Overhead Line Conductor ACSR 50/8 mm²

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Type		Aluminum conductor Steel – reinforced (ACSR)	
Nominal cross-section	mm ²	50/8	
Cross-section ratio AL/St approx.		To be specified	
Steel			
- construction	N/mm	1/3.2	
- diameter	mm	3.2	
- cross-section	mm ²	8.04	
Aluminum			
- construction	N/mm	6/3.2	
- cross-section	mm ²	48.3	
Total cross-section	mm ²	56.3	
Conductor diameter approx.	mm	9.6	
Conductor weight			
- steel	kg/km	64	
- aluminum	kg/km	132	
- grease	kg/km	0.9	
- with grease total approx.	kg/km	196	
Current carrying capacity	A	210	
Nominal conductor breaking load	KN	16.81	
Calculated conductor resistance at 20° C	Ω/km	0.5939	
Standard length per reel approx.	m	to be specified	
Dispatch reel nominal size	m	to be specified	
Standard specifications		IEC 209 DIN 48204 BS EN 50182	

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Table: Technical Data for Overhead Line Conductor ACSR 70/12 mm²

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Type		Aluminum conductor Steel – reinforced (ACSR)	
Nominal cross-section	mm ²	70/12	
Cross-section ratio AL/St approx.		To be specified	
Steel			
- construction	N/mm	7/1,44	
- diameter	mm	4.32	
- cross-section	mm ²	11.4	
Aluminum			
- construction	mm	26/1.85	
- cross-section	mm ²	69.9	
Total cross-section	mm ²	81.3	
Conductor diameter approx.	mm	11.7	
Conductor weight			
- steel	kg/km	89	
- aluminum	kg/km	193	
- grease	kg/km	1.7	
- with grease total approx.	kg/km	283	
Current carrying capacity	A	290	
Nominal conductor breaking load	KN	26.27	
Calculated conductor resistance at 20° C	Ω/km	0.4132	
Standard length per reel approx.	m	to be specified	
Dispatch reel nominal size	m	to be specified	
Standard specifications		IEC 209	
		DIN 48204	
		BS EN 50182	

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Table: Technical Data for Overhead Line Conductor ACSR 185/30 mm²

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Type		Aluminum conductor Steel – reinforced (ACSR)	
Nominal cross-section	mm ²	185/30	
Cross-section ratio AL/St approx.		To be specified	
Steel			
- construction	N/mm	7/2.33	
- diameter	mm	6.99	
- cross-section	mm ²	29.8	
Aluminium			
- construction	N/mm	26/3.0	
- cross-section	mm ²	183.8	
Total cross-section	mm ²	213.6	
Conductor diameter approx.	mm	19	
Conductor weight			
- steel	kg/km	234	
- aluminium	kg/km	507	
- grease	kg/km	4.3	
- with grease total approx.	kg/km	745	
Current carrying capacity	A	535	
Nominal conductor breaking load	KN	65.27	
Calculated conductor resistance at 20° C	Ω/km	0.1571	
Standard length per reel approx.	m	to be specified	
Dispatch reel nominal size	m	to be specified	
Standard specifications		IEC 209	
		DIN 48204	
		BS EN 50182	

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Table: Technical Data for Overhead Line Conductor ACSR 120/20 mm²

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Type		Aluminum conductor Steel – reinforced (ACSR)	
Nominal cross-section	mm ²	120/20	
Cross-section ratio AL/St approx.		To be specified	
Steel			
- construction	N/mm	7/1.9	
- diameter	mm	5.7	
- cross-section	mm ²	19.8	
Aluminum			
- construction	N/mm	26/2.44	
- cross-section	mm ²	121.6	
Total cross-section	mm ²	141.4	
Conductor diameter approx.	mm	15.5	
Conductor weight			
- steel	kg/km	156	
- aluminum	kg/km	335	
- grease	kg/km	2.9	
- with grease total approx.	kg/km	493.9	
Current carrying capacity	A	410	
Nominal conductor breaking load	KN	44.5	
Calculated conductor resistance at 20° C	Ω/km	0.2376	
Standard length per reel approx.	m	to be specified	
Dispatch reel nominal size	m	to be specified	
Standard specifications		IEC 209 DIN 48204 BS EN 50182	

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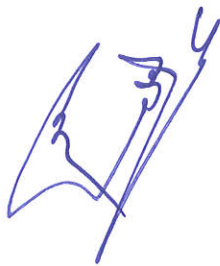
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Compression Cable Lugs

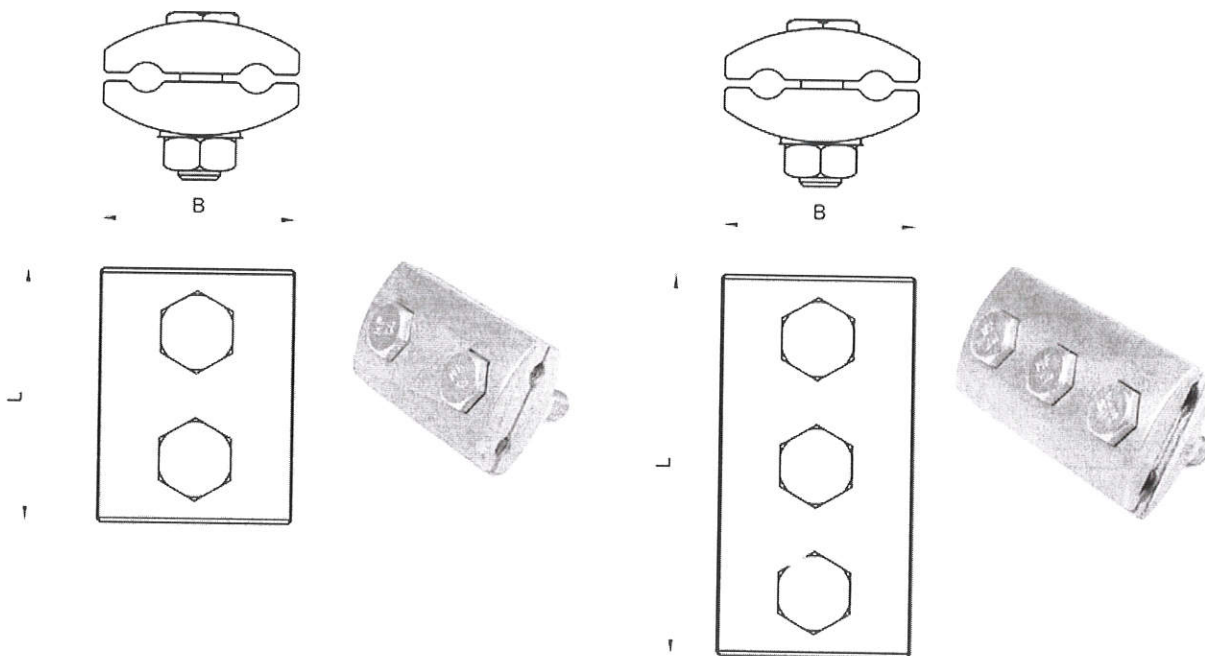
Color	Golden
Material	Copper
Size:	10-185 mm ²
Application	Power Distribution



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MATERIJAL: AL LEGURA DIN 226
STANDARD: DIN 48 075



ALAL GROOVE CLAMPS ARE USED TO JOINT TWO PARALLEL ALUMINUM ALLOY CONDUCTORS (AAAC), ALUMINUM CONDUCTORS STEEL REINFORCED (ACSR) OR ENDS OF ABC OF THE SAME OR SIMILAR CROSS SECTIONS FROM WHICH THE INSULATION HAS BEEN REMOVED. THEIR TECHNICAL CHARACTERISTICS ENABLE JOINTING OF PHASE CONDUCTORS AT THE PLACES WHERE HIGH TENSILE STRENGTH AND STIFFNESS IS REQUIRED (JOINT DONE IN ACCORDANCE WITH STANDARD DIN 48 075). ALAL GROOVE CLAMPS ARE MADE USING DIE CASTING PROCESS AND THE INSIDE GROOVES ARE COGGED, WHICH INCREASES SAFETY REGARDING PULLING OUT AND PROVIDES HIGH-QUALITY ELECTRICAL CONTACT (THE GROOVES ARE MADE IN SUCH A WAY THAT ALUMINUM OXIDE FROM THE CONDUCTOR SURFACE IS BROKEN, WHICH REDUCES TRANSITIONAL RESISTANCE BETWEEN THE CLAMP AND THE CONDUCTOR). THE BODY OF THE CLAMP IS MADE OF ALUMINUM ALLOY OF HIGH TENSILE STRENGTH AND IS CORROSION RESISTANT. THEIR TECHNICAL CHARACTERISTICS PROVIDE FAST, EASY AND RELIABLE INSTALLATION AND LONG-LIFE AND SAFE USAGE WITH MINOR LOSSES ON THE NETWORK DUE TO VERY LOW TRANSITIONAL RESISTANCE. BOLTS AND NUTS ARE ZINC PLATED. INSIDE GROOVES ARE PROTECTED WITH ELECTRICAL CONTACT GREASE. WITH ELECTRICAL CONTACT GREASE.

NOTE: ON CUSTOMER'S REQUEST THE CLAMPS CAN BE DELIVERED WITH HOT-DIP GALVANIZED OR STAINLESS STEEL X 5 CRNi 18-10 BOLT PARTS.

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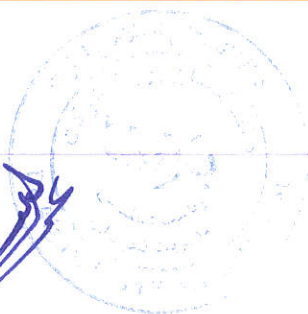


Table: Technical Data for 20 kV Fiber Tension Insulator

Designation	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type		tension insulator	
Material		silicon rubber	
Rated voltage	kV	24	
Minimum mechanical failing load	kN	70	
Height	MM	450	
Insulating distance Li.	MM	235	
Min.nominal creepage distance	MM	635	
Diameter of shed	MM	148/118	
1 min power frequency wet withstand voltage not less than	KV	42	
Full wave lightning impulse voltage (peak value)	KV	150	
Dry impulse withstand voltage:	KV	to be specified	
Minimum puncture voltage in oil	kV	to be specified	
Number of elements	number	to be specified	
Weight	kg	to be specified	
With all necessary accessories for installation standard		IEC 61109	

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Table: Technical Data for 20 kV Fiber pin Insulator

Description	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type		pin insulator	
Material		silicon rubber	
Rated voltage	kV	24	
Power frequency withstand voltage:	KV	65	
Dry Lightning impulse withstand voltage:	KV	145	
Leakage distance	mm	610	
Min Arc distance	mm	215	
Section length	mm	305	
Specified mechanical load	KN	11	
Nominal diameter "D"	mm	to be specified	
Maximum height "H"	mm	to be specified	
Min. nominal creepage distance	mm	to be specified	
Number of the fiber	number	to be specified	
Unit weight	kg	to be specified	
With all necessary accessories for Installation incl. metal thimbles threaded for screwing on to steel spindles			
Reference standard		IEC 61109	

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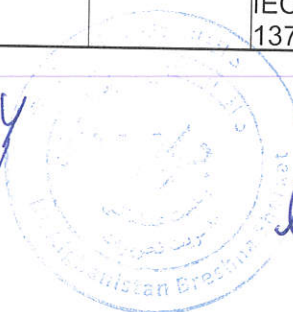
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Table: Technical Data for Low Voltage Porcelain Tension Insulator

Designation	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type		tension insulator	
Material		porcelain	
Rated voltage	kV	0.4	
Dry flashover voltage	kV	35	
Wet flashover voltage	kV	18	
One minute dry voltage	kV	32	
One minute wet voltage	kV	16	
Puncture voltage	kV	46	
Mechanical breaking load	kg	9100	
Weight	kg	to be specified	
With all necessary accessories for installation		to be specified	
Standard specifications		IEC 60383,60305, BS 137 part 2	

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Table: Technical Data for Low Voltage Porcelain pin Insulator

Designation	Unit	Required	Offered
Manufacturer's Name		to be specified	
Type		pin insulator	
Material		porcelain	
Rated voltage	kV	0.4	
Dry flashover voltage	kV	25	
Wet flashover voltage	kV	15	
One minute dry voltage	kV	23	
One minute wet voltage	kV	13	
Puncture voltage	kV	33	
Mechanical breaking load	kgf	1350	
Weight	kg	to be specified	
With all necessary accessories for Installation incl. metal thimbles threaded for screwing on to steel spindles		to be specified	
Standard specifications		IEC 60383,60305, BS 137 part 2	

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Table: LV Underground Cable 0.6/1 kV, NYY 4 x 35 RM

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Circular Stranded	
Nominal cross-sectional area of conductor	mm ²	35	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.2	
Outer sheath material		PVC	
Thickness of outer sheath	mm	1.8	
Overall diameter of cable(D)	mm	30	
Weight of cable	kg/km	1999	
Minimum bending radius	mm	12 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.628	
Max. admissible short circuit current (1s)	kA	4.02	
Current carrying capacity (in ground)	A	157	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

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Table:LV Underground Cable 0.6/1 kV, NYY- 4x 10 RM

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Circular stranded	
Nominal cross-sectional area of conductor	mm ²	10	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.0	
Outer sheath material		PVC	
Thickness of outer sheath	mm	1.8	
Overall diameter of cable(D)	mm	21	
Weight of cable	kg/km	743	
Minimum bending radius	mm	12 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 20° C	Ω/km	1.83	
Max. admissible short circuit current (1s)	kA	1.15	
Current carrying capacity (in ground)	A	60	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

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Table:LV Underground Cable 0.6/1 kV, NYY 4 x 150 SM

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor	mm ²	150	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.8	
Outer sheath material		PVC	
Thickness of outer sheath	mm	2.6	
Overall diameter of cable(D)	mm	49	
Weight of cable	kg/km	6910	
Weight of copper	kg/km	5660	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.152	
Max. admissible short circuit current (1s)	kA	17.2	
Current carrying capacity (in ground)	A	352	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

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Table: LV Underground Cable 0.6/1 kV, NYY 4 x 120 SM

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor	mm ²	120	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.6	
Outer sheath material		PVC	
Thickness of outer sheath	mm	2.4	
Overall diameter of cable (D)	mm	43	
Weight of cable	kg/km	5676	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.187	
Max. admissible short circuit current (1s)	kA	13.8	
Current carrying capacity (in ground)	A	285	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

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Table: LV Underground Cable 0.6/1 kV, NYY 4 x 70SM

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor	mm ²	70	
Insulation material of conductor		PVC	
Insulation thickness	mm	1.4	
Outer sheath material		PVC	
Thickness of outer sheath	mm	2.1	
Overall diameter of cable(D)	mm	36	
Weight of cable	kg/km	3375	
Weight of copper	kg/km	3243	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.233	
Max. admissible short circuit current (1s)	kA	8.05	
Current carrying capacity (in ground)	A	200	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502	
		DIN VDE 0271	
		VDE 0295	
		(IEC60228)	
		VDE0293	

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Table: LV Underground Cable 0.6/1 kV, NAYY 4 x 70

Designation	Unit	Required	Offered
Manufacturer's name Cable type (four – core) Conductor material Conductor shape Nominal cross-sectional area of conductor Overall diameter of cable(D) Weight of cable	 mm2 mm kg/km	To be specified NAYY Aluminium To be specified 70 36.3 1950	
Nominal voltage Service voltage Frequency	 kV kV Hz	 0.6/1.0 0.4/0.230 50	
Effective a.c. resistance at 70° C Max. admissible short circuit current (1s)	 Ω/km kA	 0.532 5.32	
Current carrying capacity (in ground) Inductance per conductor	 A mH/km	 179 To be specified	
Standards		IEC 60502	

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Table: LV Underground Cable 0.6/1 kV, NYY 4 x 185 Sm

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Cable type (four – core)		NYY	
Conductor material		Copper	
Conductor shape		Sector Stranded	
Nominal cross-sectional area of conductor	mm ²	185	
Insulation material of conductor		PVC	
Insulation thickness	mm	2.0	
Outer sheath material		PVC	
Thickness of outer sheath	mm	2.8	
Overall diameter of cable (D)	mm	54	
Weight of cable	kg/km	8596	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	0.6/1.0	
Max. Permissible operating voltage	kV	1.2	
Service voltage	kV	0.4/0.230	
Frequency	Hz	50	
Effective a.c. resistance at 70° C	Ω/km	0.143	
Max. admissible short circuit current (1s)	kA	21.3	
Current carrying capacity (in ground)	A	396	
Inductance per conductor	mH/km	To be specified	
Standards		IEC 60502 DIN VDE 0271 VDE 0295 (IEC60228) VDE0293	

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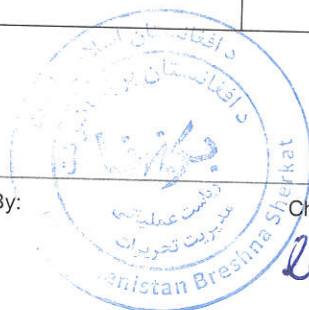


Table: MV Underground Cable 20-24 kV, N2XS2Y 1 x 50 RM/16

Designation	Unit	Required	Offered
Manufacturer's name		TO BE SPECIFY	
Type		N2XS2Y	
Conductor material and form		Copper / Circ. Stranded	
Nominal cross section of conductor	mm ²	50	
Nominal cross section of screen	mm ²	16	
Insulation material of conductor		XLPE	
Insulation thickness	mm	5.5	
Outer sheath material		PE	
Thickness of outer sheath	mm	2.5	
Overall diameter of cable (D)	mm	30.5	
Weight of cable	Kg/km	1,150	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	20	
Service voltage actual (future)	kV	20	
Frequency	Hz	50	
Effective a.c. resistance at 90° C	Ω/km	0.497	
Operating capacitance	μF/km	0.175	
Max. admissible short circuit current (1s) of conductor (screen)	kA	7.15	
<u>Installation in ground</u>			
Current carrying capacity	A	223	
Ohmic losses per cable	kW/km	To be specified	
Inductance per conductor	mH/km	0.465	
Standards		IEC 60502 IEC 60228 DIN VDE 0273 HD 620	

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Table: Technical Data for ABC Low Voltage Cables LV ABC 4 x 50 mm²

Description	Unit	Required	Offered
Manufacturer			
Rated Voltage	kV	0.6/1	
<u>Phases and Neutral</u>			
Material		Aluminum	
Cross section	mm ²	50	
Class		2	
Cross section shape		circular compacted	
Number of wires		≥6	
Diameter of wires	mm	To be specified	
Diameter of conductor	mm	8.1	
Maximum conductor DC resistance at 20 °C	ohm/km	0.641	
Insulation Material		Black XLPE	
Insulation thickness	Mm	1.5	
Breaking load of single core, min.	KN	8.4	
Breaking load of complete cable, min.	KN	28	
<u>Technical Characteristics</u>			
Outer diameter of bundle (D)	mm	27.3	
Weight of conductor	kg/km	715	
Minimum bending radius	mm	12 D	
Maximum lay of cores			
Current rating /ambient 40 °C	A	165	
Maximum conductor temperature/normal operation	°C	90	
Maximum conductor temperature/short circuit	°C	250	
Rated short circuit /phase	kA	3.6	
Length of conductor drum	m	To be specified	
Gross weight of loaded drum	kg	To be specified	
Standard		IEC 60502 NFA2X (VDE 0276 - 626 4F-1), AsXS (n) (PL WT92/K396), 1-AES (CSN 34761-4F) AS/NZS 3560.1	

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Table: Technical Data for ABC Low Voltage Cables LV ABC 4 x 70 mm²

Description	Unit	Required	Offered
Manufacturer			
Rated Voltage	kV	0.6/1	
<u>Phases and Neutral</u>			
Material		Aluminum	
Cross section	mm ²	70	
Class		2	
Cross section shape		Circular compacted	
Number of wires		≥12	
Diameter of wires	mm	To be specified	
Diameter of conductor	mm	9.7	
Maximum conductor DC resistance at 20 °C	ohm/km	0.443	
Insulation Material		Black XLPE	
Insulation thickness	Mm	1.5	
Breaking load of single core, min.	KN	11	
Breaking load of complete cable, min.	KN	39.2	
<u>Technical Characteristics</u>			
Outer diameter of bundle (D)	mm	31.3	
Weight of conductor	kg/km	960	
Minimum bending radius	mm	12 D	
Maximum lay of cores			
Current rating /ambient 40 °C	A	205	
Maximum conductor temperature/normal operation	°C	90	
Maximum conductor temperature/short circuit	°C	250	
Rated short circuit /phase	kA	5.0	
Length of conductor drum	m	To be specified	
Gross weight of loaded drum	kg	To be specified	
Standard		IEC 60502 NFA2X (VDE 0276 - 626 4F-1), AsXS (n) (PL WT92/K396), 1-AES (GSN 34761-4F) AS/NZS 3560.1	

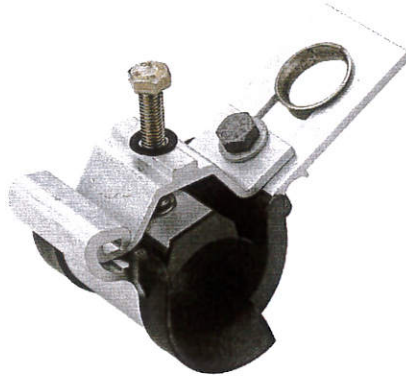
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LV ABC Cable Suspension Clamp

MODEL	CROSS-SECTION(mm2)
SM140	4 X (35-120)



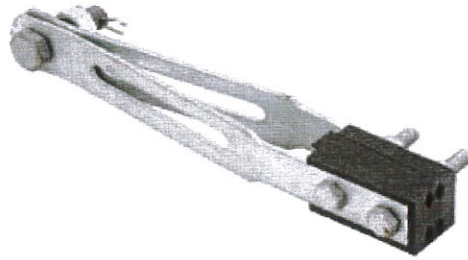
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TYPE:	insulation piercing connector
Material:	PA66
Color:	Black
Size:	16-70 mm2 & 70-70mm2



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AL-ABC - Tension Clamp

Usage	Line Fittings
Type	Tension Clamp
Conductor Range	4X(50-120)mm2
Application	Low Voltage 1kv
Materials	AL- Robber

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Copper Ground Ear thing Rod

Diameter	20mm
Usage/Application	Power Distribution Earthing
Material	Copper
Color	Copper
Length Of Rod	3000mm

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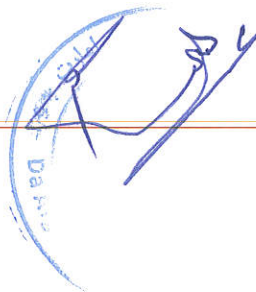
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Copper Ground Ear thing Rod

Diameter	20mm
Usage/Application	Power Distribution Earthing
Material	Copper
Color	Copper
Length Of Rod	2500mm

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Copper Ground Ear thing Rod

Diameter	20mm
Usage/Application	Power Distribution Earthing
Material	Copper
Color	Copper
Length Of Rod	1000mm

50



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A L- ACSR - Tension Clamp

Standard	GB
Usage	Line Fittings
Type	Tension Clamp
Conductor Range	1x(50-120)mm ²
Application	M- Voltage 20-24 kv
Materials	Cast iron

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Table :20 KV CT

Designation	Unit	Required	Offered
Manufacturer	-	To be specified	
Country of origin	-	To be specified	
Type	-	VB24	
Color	-	brown	
Nominal characteristics	-		
Rated max. network operating voltage	kV	24	
Rated operating voltage (Ur)	kV	24	
Rated continuous operating voltage (Uc)	kV	20	
Rated lightning impulse withstand voltage (peak)	kV	125	
Rated power frequency withstand voltage (r.m.s)	Kv	50	
Test voltage	kv	50/125	
Rated frequency	Hz	50	
Primary rated current	A	10	
Secondary rated current	A	5	
Rated short-time Thermal current [1s]	A	To be specified	
Rated dynamic current	kA	To be specified	
Accuracy class		0.2	
Weight approx.	kg	To be specified	
Standard		IEC – 60044-1/6	

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Table :VT-20KV

Manufacturer		To be specified	
Country of origin		To be specified	
Type		VB 24	
Test voltage for Equipment Um (r.m.s)	kV	24	
Rated power frequency with stand voltage (r.m.s)	kV	50	
Rated lightning impulse withstand voltage (peak)	KV	125	
Heist voltage for equipment Um (r.m.s)	kV	24	
Test voltage	KV	50/125	
Rated frequency	Hz	50	
Rated primary voltage Um [max]	KV	20/ $\sqrt{3}$	
Secondary voltage	V	100/ $\sqrt{3}$	
Rated burden in class 0.2,0.5,1.5	VA	20	
Thermal limiting current for earth fault detection winding	A	6	
Rated voltage factor [8h]		1.9Un	
Weight [approx.]	Kg	To be specified	
Accuracy class		0.2	
Standard		IEC 600442 IEC 61869	

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20kV Indoor Metal Clad Switchgear Panels

57-58-59



1 GENERAL SPECIFICATIONS

1.1 General

This Specification covers the Design, construction and testing of 20kV Indoor Metal Clad Switchgear Panels which have used for 13.8kv as well.

Subsequent paragraphs will give detailed descriptions and requirements for the Switchgear Panels, including Circuit Breakers, Current Transformers, Voltage Transformers, Protection Relays, Metering, Measuring, Indicating and Control devices and other equipments/Devices, specified herein.

1.2 STANDARDS

Ratings, characteristics, tests and test procedures, etc. for the 20 kV metal-clad switchgear panels and all the protection relays, measuring and indicating instruments and the control and monitoring devices and accessories, including current transformers and voltage transformers shall comply with the provisions and requirements of the standards of the international electro- technical commission (IEC), and also relevant ANSI standards where specified.

The latest revision or edition in effect at the time of bid invitation shall apply. Where references are given to numbers in the old numbering scheme from IEC it shall be taken to be the equivalent number in the new five-digit number scheme.

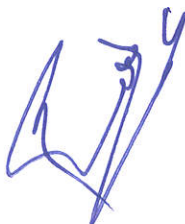
1.3 UNIT OF MEASUREMENT AND LANGUAGE

In all correspondence, in all technical schedules and on all drawings prepared by the manufacturer, the metric units of measurement shall be used. On drawings or printed pamphlets where other units have been used, the equivalent metric measurements shall be added. All documents, correspondence, drawings, reports, operating and maintenance instructions/manuals and nameplate details of the equipment shall be in English language.

1.4 SERVICE CONDITIONS

Switchgear room Temperature.

The switchgear shall be installed in a room without air conditioning but with ventilation to allow natural cooling. Therefore all the protection and control devices employed shall be capable of operating in this environment without failure for their designed life time. Particularly the power supply modules of the protection and control devices shall be designed for minimum heat generation and effective heat dissipation to ensure that the temperature of these devices enclosed in the relay panels at the above listed ambient temperatures shall not exceed the maximum operating temperature of the device.



1.5 WORKING STRESS AND EQUIPMENT/APPARATUS DESIGN

1.5.1 General

- a) The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations, which might adversely affect the operation of the equipment. Mechanisms shall be constructed to avoid sticking due to rust or corrosion.
- b) The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner with materials best suited to their respective purpose and generally in accordance with up-to-date recognized standards of good practice.
- c) The equipment shall be designed to cope with seismic conditions.
- d) Whenever possible, all similar parts, including spare parts, shall be made interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerances as to enable substitution or replacement by spare parts easily and quickly.
- e) All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of vermin and dust and accidental contact with electrically energized or moving parts. The switchgear panels shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to be obtained in a desert climate and where the switchgear is called upon to frequently interrupt fault currents on the system and also where the duty of operation is high.

1.5.2 Strength and quality

- a) All steel castings and weldings shall be stress-relieved by heat treatment before machining, and castings shall be stress-relieved again after repair by welding.
- b) Liberal factors of safety shall be used throughout, especially in the design of all parts subject to alternating stresses or shocks.

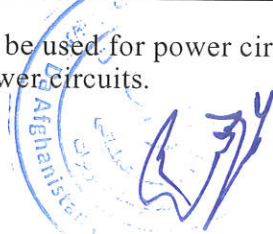
1.5.3 Design data low voltage equipment

Low voltage equipment and installation shall be designed in accordance with EMC directives. The rating and design criteria for low voltage equipment shall be as follows:

a) AC Supply Rating system

Rated voltage between phase	400 V AC
Connection type	3ph 4wire
Rated voltage between phase to earth	230 V AC
Grounding system	Solid
Frequency	50 HZ
Voltage variation	+/-10%
Frequency variation	+/-2%
Power frequency 1 min, Test Voltage	3 kV
Thermal rating of conductors	120 % of load
Max short-circuit Current	12 KA 1 sec

The AC supply shall be used for power circuit and for lighting, indication, motor controls and similar small power circuits.



Unless otherwise specified, the equipment provided under this tender is to be capable of reliable operation at voltages as low as 80% of the rated voltage, and to withstand continuously up to 110% supply voltage above the rated value of 230V or 400V AC.

b) DC Auxiliary Supply Rating

Equipment/Device Rated voltage	110V DC
Connection type	2 wire
Voltage variation	As per standard

1) The auxiliary dc supply shall be used for controls, indication, alarm, protection relays, and circuit breaker tripping and closing circuit, etc.

2) All equipment and apparatus including the circuit breakers, protective relays, control devices and accessories, measuring and indicating instruments and electronic equipment shall be capable of satisfactory operation at 80% to 125% of the rated dc supply voltage. All tripping coils shall be capable of operating at 70% to 125% of rated DC supply voltage.

1.5.4 Design data for Medium voltage plant and equipment

The rating and design criteria for the MV plant and equipment shall be as follows:

Item	Parameters	SYSTEM PARAMETER
1	System description	50 Hz, 3 phase, 3 wire
2	Neutral point earthing	Solid earthed

MEDDIUM VOLTAGE SWITCHGEAR SPECIFICATION TABLE for 20KV KV Data sheet which is used for 13.8kv as well,

DESCRIPTION	UNIT	REQUIRED VALUE
Quantity Required	Each	1 (One) unit
Type		Indoor Class, Metal-Clad, MV, Draw-out type Vacuum Circuit breakers, Single bus, two sections, 50Hz
Switchgear		
Nominal System Voltage	kV	20kV
Maximum Nominal System Voltage	kV	24kV
Rated Frequency	Hz	50
BIL rated	kV	150kV
Continuous current (feeder breakers & auxiliary transformer)	A	630A
Continuous current (Incomer)	A	1250A
Continuous current Bus Bar	A	2500A
Closing and latching capability(Making)	kA	62.5 kA
Rated insulation Level:		
One minute power frequency withstand voltage	kV	50
Impulse withstand voltage	kV	125

a) Switchgear shall electrically be designed to avoid local corona formation and discharge likely to cause radio interference.

b) The design of jointing of adjacent metal parts and surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service conditions.



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c) Particular care shall be taken during manufacture of busbars and fittings and during subsequent handling to ensure smooth surface free from abrasion. All joints on the busbars and the circuit within the switchgear board shall be silver or tin-plated to ensure good electrical connection.

1.6.3 Switchgear Panels

(a) The switchgear panels shall be dead-front, floor-standing, rigid welded steel frames, completely enclosed by metal sheets and suitable for indoor installation.

(b) The floor-standing switchgear panel shall have provision for bolting to the floor.

(c) Suitable terminal blocks shall be provided for all outgoing power and control cables. All cable terminals shall generally be located for bottom entry and connections.

(d) The Switchgear panels shall be painted to RAL 7032 color.

(e) Enclosures for the switchgear panel and for other electrical equipment shall have the following degree of protection (ref IEC 60034, IEC 60529 and IEC 60947):

Equipment	Degree of protection
Medium voltage enclosed switchgear	IP 41
Indoor control and relaying equipment	IP 51

(f) Interior illumination lamps operated by door switches shall be provided for each switchgear control compartment. The Lamps should be easily available in the local market for future replacements. One 230V socket outlet of 3-point square terminals shall be provided for each switchgear panel in the control compartment.

(g) Space heaters for 230V AC shall be provided inside the switchgear panel, circuit breaker and control compartments to prevent moisture condensation. A hygrostat control unit with variable temperature and humidity control setting shall be installed to control the heater.

1.6.4 Measuring instruments

a) All measuring instruments, including energy meters, shall be of flush-mounted, back-connected, dust-proof and heavy-duty switchboard type. Each measuring instrument shall have a removable cover, either transparent or with a transparent window. Each instrument shall be suitable for operation with the instrument transformers detailed in this specifications, under both normal and short-circuit conditions.

b) For analog type instruments, scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings. The scale range shall be determined from the current transformer and voltage transformer ratios and is given in the detailed specifications for each instrument.



c) All measuring instruments of analog type shall be approximately 110mm² enclosures and shall be provided with clearly readable long scale, approximately 240 degrees. The maximum error shall be not more than one and a half (1.5) percent of full-scale range.

1.6.5 Indicating lamps

a) Indicating lamp assemblies shall be of the switchboard type, insulated for 110 V DC service, with appropriately colored lens. The lens shall be made of a material, which will not be softened by the heat from the lamps.

b) For the circuit breakers, red indicating lamps shall be used for "ON" position, green lamps for "OFF" position indication and amber for circuit breaker auto trip.

1.6.6 Nameplates

a) Nameplates

Each cubicle, panel, meter, switch and device shall be provided with a nameplate or escutcheon plate for identification with English description and also where appropriate the IEC number on the front of the panel directly below each device as appropriate. On the inside of the control compartment of the switchgear panel, a white label, engraved in Black Letters and Numbers shall be fixed on or below each device. The device name/number fixed on the inside of the control compartment shall correspond to the name/number used in the drawings. Each equipment shall be provided with a rating plate containing the required information as specified in the relevant IEC standards.

b) The plates shall be made of stainless steel and shall not be deformed under the service conditions at the site. The entries on the plates shall be indelibly marked by engraving with black letter on a white background or vice versa as specified.

1.6.7 Wiring

a) General

i) All wiring inside the switchgear panel shall be done with PVC insulated wire not less than 2.5 sq.mm, flexible cable. A suitable wiring duct system firmly fixed on the panel and having covers shall be installed for all inter-panel and front-to-rear panel wiring as well as for wiring within the panels, which will provide easy access for inspection and replacement of the wires.

ii) Wiring between terminals of the various devices shall be point to point. Splices or tee connection will not be acceptable. Wire runs from the duct to the device shall be neatly trucked or clamped.

iii) Exposed wiring shall be kept to a minimum, but where used, shall be formed into compact groups suitably bound together and properly supported.

iv) Instrument transformer secondary circuits shall be grounded only on the terminal block in the control compartment. Facilities for short circuiting the current transformers secondary windings while the switchgear panel is in service shall be provided.



v) Cable supports and clamp type terminal lugs shall be provided for all incoming and outgoing power wiring terminated at each panel. All wiring conductors (wires) shall be marked at each point of termination onto the terminal block or device. These wire markers shall be of an approved type and permanently attached to the conductor insulation. The method of ferruling shall be subject to approval by the employer; it is however preferred that the wire marker (ferrule) correspond to the device number or terminal block number and the number of the terminal where it is connected. All the devices and the terminal blocks must therefore have unique numbers.

b) Phase arrangement

The standard phase arrangement when facing the front of the panel shall be R-Y-B-N, and P-N from the left to right, from top to bottom, and front to back for A.C three-phase and single-phase circuits. For DC circuit it shall be N-P from left to right, P-N from top to bottom and front to back. All relays, instruments, other devices, buses and equipment involving three- phase circuit shall be arranged and connected in accordance with the standard phase arrangement wherever possible.

(c) Wiring color code

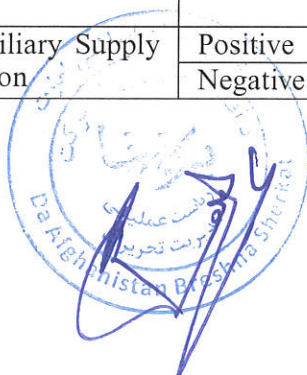
All wires shall have ferrules at all terminations to distinguish each wire and terminal. In addition, the wire shall have the following colors:

Circuit	Color
Voltage transformers/ Current Transformers	R, Y, B, BLK
Auxiliary A.C. supply connection cable/bus-wires	Brown and Black
D.C. control wiring within the panel	Grey
Grounding/earthing cable/wire	Green with yellow stripe

(d) Phase and polarity color code

Following colored ferrules shall be provided on each wire in order to identify phase and polarity.

Phase and Polarity		Color
A.C., three-phase, for CT and VT secondary Wiring	First phase	Red
	Second phase	Yellow
	Third phase	Blue
	Neutral	Black
A.C, single-phase,	First phase	Red
	Neutral	Black
	Ground	Green with yellow stripe
DC auxiliary Supply connection	Positive	Brown
	Negative	Black



1.6.8 Terminal blocks

- a) Terminal blocks for control wiring shall be rated not less than 600V AC.
- b) White or other light-colored marking strips, fitted to each block, shall be provided for circuit designation.
- c) The terminal arrangement, including the terminal blocks for VT and CT circuit connections, shall be subject to the employer's approval. A Total of not less than 20 spare terminals shall be provided for future use.
- d) Shorting Links shall be provided on the current transformer (CT) circuits on the terminal block.
It shall be possible to short the CTs under live system conditions without open-circuiting the CTs.
- e) Isolation links (sliding Links) shall be provided on the trip circuits, alarm and on the VT circuits
to allow easy isolation of these circuits without disconnecting the wires from the terminal block.
- f) Each individual terminal block shall be marked with a distinctive number, which shall be the same number used in the drawings, for identification purposes. The TB number shall be engraved in black numbers in white background and shall be durable so as to last the life time of the switchgear board.
- g) Each set of terminal block shall be identified by a label to distinguish it from another set of terminal block. The numbers used to mark the terminals on the terminal blocks shall be unique. The labels used will match those used in the drawings.

1.7 EQUIPMENT AND SWITCHGEAR EARTHING

GENERAL

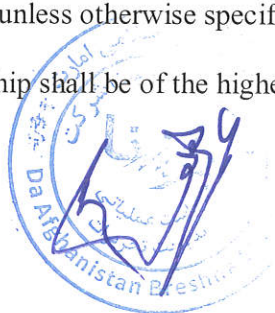
All the Compartments including the hinged doors of the Switchgear Panels and all the earthing points of the equipment installed/mounted in the Switchgear panels shall be connected to the grounding conductor at the bottom of the panel for external connection to the substation earthing system.

Earthing conductors shall be of annealed high conductivity copper stranded in accordance with Table 4 in BS.6346 and protected with an extruded PVC sheath of 1000 volts grade. The earthing conductor on the primary equipment such as the Earth Switch and also for inter-panel earth-bonding as well as for external connection to the substation Earthing - grid shall be adequate to carry the rated switchgear short-circuit current of 25 kA for 3 seconds.

1.8 MATERIALS AND WORKMANSHIP

1.8.1 General

- a) Materials shall be new; the best quality of their respective kinds and such as are usual and suitable for work of like character. All materials shall comply with the latest issues of the specified standard unless otherwise specified or permitted by the employer.
- b) Workmanship shall be of the highest class throughout to ensure reliable and vibrations



free operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.

c) All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes

1.8.2 Assembly

Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC as specified under each equipment in these specifications to demonstrate to the satisfaction of the employer that the switchgear panels comply with the requirements of the relevant IEC standards.

1.8.3 Casting

Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

1.8.4 Welding

a) Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used.

1.8.5 Color standard

The final color of each item shall be as described under each item.

1.8.6 Operational Details

Instructions shall be engraved on the switchgear panel, on the circuit breaker compartment describing in simple steps how to carry out correct and safe isolation, racking-in and racking-out switching operations on the circuit breaker. Similar details should be provided for the operation of the earth switch.



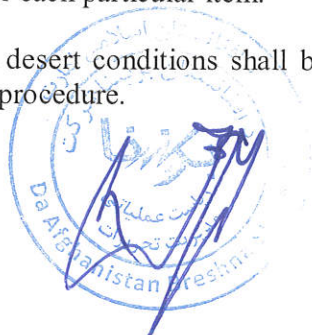
1.9 PROTECTION, CLEANING AND PAINTING

1.9.1 Embedded steelwork

All parts to ultimately be buried in concrete shall be cleaned and protected before leaving the manufacturer's plant by cement wash or other approved method. Before being installed they shall be thoroughly desiccated and cleared of all rust and adherent matter, or be treated according to a method approved by the Employer. Such cleaning or treatment shall not detrimentally affect the strength or final operation and function of the equipment.

1.9.2 Steel exposed to atmosphere

- a) All machined parts or bearing surfaces shall be cleaned and protected from corrosion before leaving the manufacturer's plant by the application of an approved rust preventive coating, or a peelable plastic film. Where the latter is impracticable, such parts shall be heavily covered with high melting point grease. After erection such parts shall be cleaned with solvent and lapped or polished bright.
- b) All parts, other than machined parts, which will be exposed after erection shall be thoroughly cleaned and galvanized or given with two coats of best quality approved primer and one coat of best quality approved finish paint before leaving the manufacturer's plant and a further one coat of paint of an approved quality and color after erection and touching up on the site, except such apparatus as panels and instruments which shall be finished painted under approved procedures.
- c) All outside panel surfaces shall be primed, filed where necessary, and given not less than two coats of synthetic undercoat. The finishing coat for the outdoor and indoor installations shall be a gloss paint.
- d) Primer shall be applied to surfaces prepared in accordance with the plant manufacturer's instructions. The surface shall be wiped clean immediately prior to applying the paint. The primer and finish coats of paint shall be applied using the methods and equipment recommended by the manufacturer.
- e) The internal surface of all pipelines shall be cleaned out by the approved methods before installation and again prior to commissioning, to ensure freedom from dirt, rust, scale, welding slag, etc. all exposed pipes shall be painted with an identifying color after erection is completed. The color code system shall be approved by the employer.
- f) All steel surfaces, which are in permanent contact with oil, shall be given three coats of approved oil resistant.
- g) ~~No painting or protection is required for finished or unfinished stainless steel parts.~~
- h) The final color of all equipments, frames for meters and relays, and switch handle shall be as described under each particular item.
- i) The humid and desert conditions shall be taken into account on selection of the paints and painting procedure.



1.10 DRAWINGS

a) Before starting manufacture of the switchgear panels, dimensioned drawings and data showing all significant details of the equipment and materials to be used shall be submitted to the employer for approval. Where the drawings are Not approved, the manufacturer shall modify the drawings as per the Employers comments and in line with the specifications and re-submit to the Employer for review.

b) The manufacture of the switchgear shall then proceed strictly in accordance with the approved drawings and also in accordance with the detailed specifications as contained herein. Where conflict may arise between the specifications and the approved drawings, the specifications will take precedence, unless it's specifically indicated in writing on the approved drawings that the conflicting clause in the specifications is superseded, or where following discussions between the manufacturer and the employer, the employer gives approval in writing to supersede the conflicting clause in the specifications.

c) All drawings submitted for approval or sent to the Employer for any other reason shall be in hard copy form and shall be sent by courier.

d) On successful completion of the initial FATs and following completion of the manufacture of the complete switchgear panels, the manufacturer shall carry out all the tests required, for the completed switch board and for current transformers, voltage transformers, circuit breakers and for protection relays. The above tests shall be carried out on each and every switchgear panel. Any problems noted will be rectified and the Employer will only be invited to the factory when all the tests are successful. This will ensure that the employer does not spend time in the factory waiting for the manufacturer to fix problems that arise during the FATs, while such anomaly would have been detected and rectified by the manufacturer before hand over after conducting the above routine tests.

e) Upon testing of the panels as in d) above the drawings will be edited to capture any minor wiring errors detected in order to produce the final As built drawings. A copy of the final As Built drawings and Routine test results for each panel, signed by the Manufacturer shall be sent by courier to the employer before attendance of the FATs.

f) Each individual switchgear panel shall have its own separate drawing, with the name of the panel included on the drawing for identification.

g) Before Approval of shipment of the switchgear panels, Three (3) copies of bound As Built drawings (A4 size) in Hard Copy shall be forwarded to the employer in Durable Hard cover Box Files. The files shall have a tag with the following Inscription.

Project Owner.

Also two (2) software copies (in CD ROM) of the As Built drawings in AutoCAD Electrical 2010SLM or later version shall be sent to the employer via courier. The CD ROM will have the same label as above. The drawings provided on soft copy shall be freely editable to allow the employer to incorporate any changes made in future.



All protection and control drawings shall be done on A4 - size paper. The function of each drawing shall be clearly indicated. Related drawings shall be arranged sequentially, and have the same drawing number/name but different sheet numbers. The drawings shall include the following;

- AC single line drawing
- AC Schematics
- DC Schematics
- Functional Drawings
- Panel wiring, including inter-panel bus-wiring List
- Panel device layout drawing
- General layout drawings for the switchgear panels
- Relays and device list (bill of quantities) for each type of panel.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

a) The manufacturer shall supply detailed instruction manuals concerning the correct manner of assembling/installing, configuring, setting, testing and commissioning, operating and maintaining the equipment and devices constituting the switchgear board, including the board itself. The maintenance details of each component shall also be described, including the frequency of inspections and lubrication.

The instruction manual shall include a separate and complete section describing the normal and emergency operating procedures for the switchgear, and shall include explanatory diagrammatic drawings to facilitate understanding of the instructions.

b) The manufacturer shall, in preparing the instruction manuals, take into account the lack of experience and familiarity of the operators with this type of equipment.

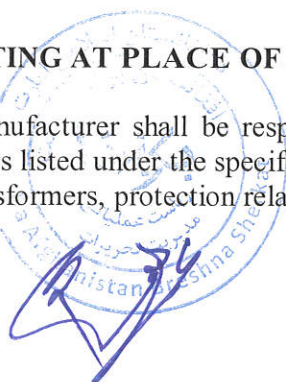
c) **One complete set of the operating and maintenance manuals for all the plant, equipment and accessories to be installed/mounted in the switchgear panels shall be sent to the employer together with the drawings for approval.** The operating and maintenance manuals shall be original copies printed and bound by the manufacturer. Any illegible copies of the operating and maintenance manuals submitted shall be rejected by the employer.

d) Before approval of shipment of the switchgear panels, Four (4) Copies of the operating and maintenance instructions/manuals shall be sent to the employer by courier. The operating and maintenance manuals shall be original copies printed by the manufacturer. Any illegible copies of the operating and maintenance manuals submitted shall be rejected by the employer.

In addition, three (3) softcopies of the manuals in CD Rom shall be delivered to the employer.

1.12 TESTING AT PLACE OF MANUFACTURE

a) The manufacturer shall be responsible for performing or for having performed all the required tests listed under the specification for the switchgear and all the current transformers, voltage transformers, protection relays, energy meter, measuring and indicating instruments.



b) The tenderer shall confirm the manufacturer's capabilities in this regard when submitting tenders.

Any limitations shall be clearly specified.

c) Tender documents shall be accompanied by copies of Type test and Routine test reports & certificates for similar rated equipment for the purpose of tender evaluation. Type test reports & certificates shall be certified by the National Standards and Testing Authority (NSTA) of the country of origin or by a third party Reputable Testing Authority. Where a body other than NSTA is used to certify the type-test reports, a copy of the certificate of accreditation shall be attached. Current contact information of the testing and certification authority shall be provided.

d) Upon completion of the manufacturing process, routine tests shall be carried out as per the respective IEC standards of each equipment as follows:-

1. Circuit Breaker IEC 62271-100 & IEC 60298
2. Switchgear panels, IEC 60294
3. Current Transformers, IEC 60044-1
4. Voltage Transformer, IEC 60044-2
5. Protection Relays and Measuring and Indicating Instruments, IEC 60255

e) The contractor shall arrange for (two) 2 engineers from the employer attend Factory Acceptance Tests(FATs) on the Switchgear panels, where all routine tests as per the IEC standard listed above and other special tests listed in this specifications shall be carried out in their presence. The duration of the FATs shall be adequate to test all the offered switchgear boards. Testing shall strictly be carried out during working hours from 8.00 am to 5.00 pm.

The employer's engineers will only sign the Tests Reports/certificates only when the tests are conducted in their presence in accordance with the relevant IEC standard or the procedure agreed before hand over between the employer and the manufacturer.

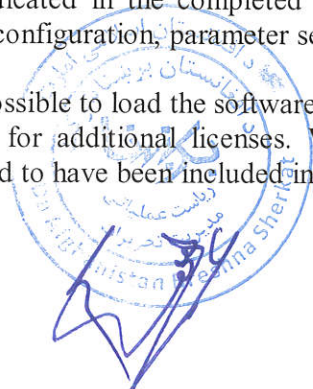
f) Only upon receipt of authentic certified copies of the FATs Routine Test Reports/certificates and special tests and satisfactory report from the engineers, shall the employer give clearance for shipment of the switchgear boards once all the other listed requirements on drawings, operation and maintenance manuals and software have been met.

1.13 SOFTWARE REQUIREMENT

Three (3) copies of each different type of software in a CD ROM, for the protection relays, energy meters, transducers and other measuring devices whose configuration and settings is software based shall be supplied with the board. Two sets of connection cable for each type of device shall also be supplied with the switchgear board.

Before approval for shipment of the switchgear board is granted by the employer, all the software indicated in the completed technical schedules shall be supplied. The software shall be for configuration, parameter setting and for data download and analysis.

It shall be possible to load the software into at least ten (10) different laptop computers without requirement for additional licenses. Where additional licenses are required, the cost shall be considered to have been included in the bid.



Four (4) sets of hard cover manuals for each type of software supplied providing detailed instructions for programming settings and configuration of the relays and other devices and downloading of data, shall be supplied with the switchgear

1.14a SPARE PARTS

The manufacturer (bidder) shall furnish spare parts as listed below and included in the price schedules:

- i. Ten (10) circuit breaker closing coils
- ii. Ten (10) circuit breaker tripping coils
- iii. Four (4) circuit breaker interlocking coils
- iv. Four (4) earth switch interlocking coils
- v. Ten (10) indication lamps of each type

a) The spare parts supplied shall be packed or treated in such a manner as to be suitable for storage under the climate conditions at the site for a period of not less than two years, and each part shall be clearly marked with the description and purpose on the outside of the package

b) Spare parts so provided shall be delivered with the switchgear to the employers stores. Delivery of spare parts will not be deemed to be complete until the packages have been opened and their contents checked and verified by a representative of the employer.

1.14b ACCESSORIES FOR THE SWITCHGEAR BOARDS

The following accessories shall be supplied with each separate switchgear board:-

- i) Four (4) circuit breaker rack in/rack out handle/tool
- ii) Four (4) circuit breaker manual spring charging handle/tool
- iii) Four (4) earth switch operating handle/tool iv) Two (2) circuit breaker withdrawal trolley

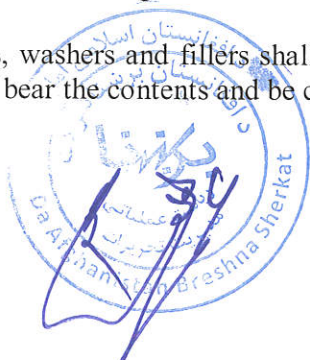
1.15 PACKING

a) The switchgear panels and spares shall be packed properly and protected for shipment from the place of manufacture to the employer's stores.

b) Each crate of package shall contain a packing list in a waterproof envelope and a copy in triplicate shall be forwarded to the employer prior to dispatch. All items of material shall be clearly marked for easy of identification against the packing list.

c) All cases, packages, etc. shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.

d) Bolts, nuts, washers and fillers shall be bagged in sealed vinyl and packed in steel cans. The cans shall bear the contents and be crated together.



e) The Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not relieve the manufacturer from responsibility for any loss or damage due to faulty packing.

2.0 DETAILED TECHNICAL SPECIFICATIONS FOR 20KV METAL CLAD INDOOR SWITCHGEAR PANELS.

2.1 SCOPE

This specification is for 20 kV Indoor, three pole, metal clad switchgear with vertical or horizontal isolation, horizontal draw out with circuit breaker employing vacuum interrupter.

2.2 REFERENCES

The following documents were referred to during the preparation of this specification, and may be referred to; however in case of conflict, the provision of this specification shall take precedence.

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

IEC 60298: AC metal - enclosed switchgear and control gear for rated voltages above 1kV and up to 72.5 kV

Direct acting indicating analogue electrical measuring instruments and their accessories.

IEC 62271-100 High-voltage alternating circuit breakers. IEC 60044-1: Current transformers

IEC 60044-2: Voltage transformers

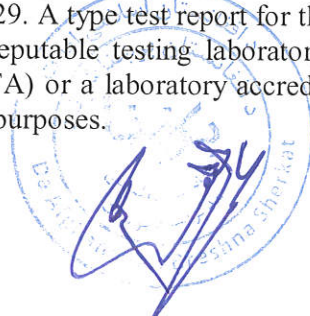
IEC 60255: Electrical Relays

ANSI 37: Medium voltage AC metal - enclosed switchgear and control gear

2.3 CONSTRUCTION OF EACH PANEL:

a) The whole switchgear equipment and components shall be designed and constructed in accordance with IEC 60298. The board shall be complete with all the relevant components including, busbars, circuit breaker, cable compartment, instrument transformers, protection relays, instruments and controls.

b) The switchgear board, shall be constructed to IP41 degree of protection in accordance with IEC 60529. A type test report for the degree of protection of the switchgear panels from a third party reputable testing laboratory or certified by the national standards and testing authority (NSTA) or a laboratory accredited to the NSTA shall be submitted with the tender for evaluation purposes.



c) For panels in the scope of supply only: The panels shall have restricted dimensions suitable for installation in limited spaces. In particular and without compromising the insulation level, bus - bar current rating and short circuit current performances, the width of the panels shall not exceed **800mm**.

The LV compartment shall not be less than **650 mm** in height, to ensure adequate space for mounting the relays and other devices and accessories and adequate space for the cable trucks, terminal blocks and wiring.

The depth of the switchgear, i.e., from the front to the back shall be kept to the minimum and in any case not exceeding **1800 mm**.

d) The switchgear panel or cubicle shall be built up of separate metal clad-compartmented cubicles with earthed metal partitions. The compartments shall be for busbar, cable connection, circuit breaker, current transformer and control (LV) compartments. A drawing showing the layout and dimensions of each of the compartments of the switchgear panel and the devices/components installed in the compartment shall be submitted with the bid for tender evaluation. Also a drawing showing the arrangement and dimensions of a complete switchgear board, comprising One incomers, 5 feeder panels assembled together shall be included with the bid for tender evaluation. The drawing shall also include the arc venting chamber to be supplied with the switchgear board. Different drawings shall be provided for the switchgear board rated 25 kA respectively.

e) The circuit breakers shall be mounted on an inbuilt carriage to facilitate isolation and withdrawal of the circuit breaker. Where the carriage is fixed in the compartment and does not allow complete withdraw of the circuit breaker outside it's compartment, then a purposely built trolley shall be provided equipped with a lowering/raising gear to lower the circuit breaker to the floor, and to raise the circuit breaker to its compartment by one person. This requirement shall be demonstrated during FATs.

f) The complete switchgear shall be such that the complete switchboard is of flush-front design.

g) Each of the switchgear panels shall have four separate compartments as follows :- i)

LV compartment

ii) Circuit Breaker compartment

iii) Bus bars compartment

iv) Cable, CTs, VTs and Earth Switch compartment

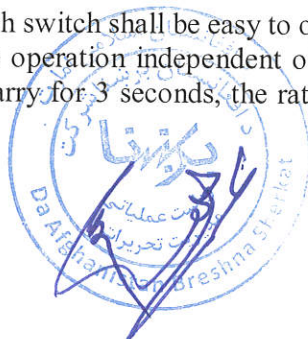
The circuit breaker, bus bars and cable compartments shall be provided with arc venting outlet to the top of the switchgear board.

The top of the complete switchgear board shall be equipped with arc by-products venting chamber to direct the arc by products outside the switchgear room. The design of the arc chamber shall be adequate to handle arc by products at the rated withstand level of the switchgear board of 25 kA, 3 seconds. The design of the arc chamber shall be complete in every way with provision of connection to the switchgear wall at least at two points and the terminal explosion flaps to be fitted on the switch gear wall.

h) The low voltage section shall be completely separate from the high voltage section. All the protection relays, auxiliary relays, energy meters indication lamps, instruments, control

and selection switches and any other associated accessories will be mounted in this compartment.

- i) The switchgear shall be designed for erection with the rear side close to a wall as well as for free standing erection. The manufacturer shall provide a single line layout drawings giving the required minimum dimensions of the switchgear room, including arc by-products venting requirements to be provided (built into) in the switchgear room.
- j) The switchgear shall be of arc resistant design as per IEEE/ANSI C 37.20 and hence ensure complete safety for a switching personnel standing in-front or at the rear of the switchgear board. A copy of the type test report shall submitted with the bid for tender evaluation purposes.
- k) Where the venting is intended to penetrate an external wall, the vent shall be covered such that it meets all environmental conditions (e.g. rain-proof, dust-proof, vermin-proof).
- l) The cable compartment should have an ant vermin guard plate giving protection against rats, rodents etc.
- m) The circuit breaker compartment door shall be provided with provisions for padlocking.
- n) The doors shall be capable of withstanding the effects of maximum internal arcing fault without being blown off and causing danger to personnel and other equipment. This should be proven by successful testing, as per ANSI C 37.20.7 or equivalent IEC standards. Type test report shall accompany the bid.
- o) The busbar shall be single, three phase, air insulated. The primary busbars and connections shall be of high conductivity and electrolytic material, high grade copper, and shall be in unit lengths. The busbars shall preferably have a PVC cover to prevent accidental short-circuits
- p) Busbars, connections and their support shall be rated 1600 A as required continuously under ambient conditions and capable of carrying the short-time current associated with the short circuit ratings of the circuit breakers, for 3 Seconds.
- q) Busbars shall be extensible at both ends, such extension shall entail the minimum possible disturbance to the existing busbar.r) Provision shall be made for locking busbar and circuit shatters separately in the circuit breaker compartment. These shutters shall open and close automatically during the racking in and racking out of the circuit breaker.
- s) Provision shall be made for integral circuit earthing and for busbar earthing. Means of earthing shall be by circuit breaker or purposely built earth switch. Mechanical interlocks to ensure correct switching operation shall then be provided. It shall not be possible to close the earth switch on the incomer panel, when the incoming 20kV cable is live.
- t) The earth switch shall be easy to operate by one operator and be spring loaded to ensure effective make operation independent of the operator action. The earth switch shall be rated to make and carry for 3 seconds, the rated short-circuit current of 25KA.



The Status of the earth Switch shall be visible from the front of the Panel. It shall not be possible to rack-in the circuit breaker into the service position with the earth switch in closed position. The mechanical interlock between the circuit breaker and the earth switch shall be strong enough to guarantee safety of the switching personnel and the switchgear.

The earth switch shall be equipped with auxiliary contacts for local and supervisory indication of the status of the earth switch. The earth switch operating lever shall be covered by a shutter and shall only be accessible when it is permitted to operate the earth switch.

u) The operation of the Earth Switch shall be set in such a way that during both the close and open operations, a clearance of at least 9 inches shall be maintained between the operating handle and the bottom of the switchgear panel.

v) It shall not be possible to insert the earth switch operating handle into position except when the circuit breaker is in the test or isolated position. The earth switch shall be equipped with pad- locking facilities when in the closed position

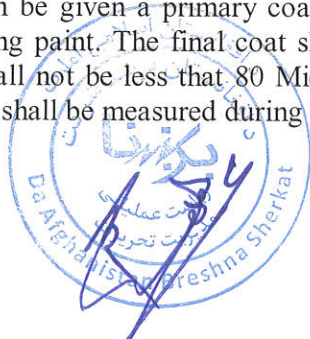
w) All earthing facilities shall be rated for fault making at the rated switchgear short-circuit current.

x) Earthing switches shall be provided for earthing each of the Busbar Sections separately. All the interlocks required to ensure safe operation of the busbar earth switch shall be built into the switchgear board. In particular it shall not be possible to close the earth switch when any of the circuit breakers on that part of the busbar is in service position, i.e., all the circuit breakers shall be withdrawn for the Busbar earth to be closed. Once the Busbar earth has been closed, it shall not be possible to rack-in any circuit breaker. Indications for busbars earth On and OFF shall be provided and visible from the front of the board.

The Panel wiring for protection, instruments, indication and metering circuits and other control accessories shall be completely done. All circuits for connection to external cables such DC & AC auxiliary supplies, external tripping, supervisory control and indications shall be wired up to the terminal Block at the Back of the panel where external cables shall be connected. At least 12 spare terminals shall be provided on the terminal board for any future requirements.y) It is emphasized that Each Switchgear panel will have a terminal block at the back of the panel where all external cables such as for 110V DC supply, 230V AC supply, connection of SCADA, positions/ measurements/commands and alarms shall be made.

z) 110V DC, 230V AC supplies for circuit breaker control, alarm circuits, protection relays, metering and motor supply for each panel, shall be controlled by suitably rated miniature circuit breakers.

aa) The switchgear panels shall be vermin proof. The plates shall be of high quality mild steel of at least 2mm thickness thoroughly cleaned by shot blasting or other approved methods. They shall then be given a primary coat and two coats of contrasting color of durable and weather resisting paint. The final coat shall be gloss and of RAL 7032. The final thickness of the paint shall not be less than 80 Microns at any point within the switchgear panel. The paint thickness shall be measured during the Factory Acceptance Tests.



bb) Anti-condensation heaters shall be provided inside each switchgear panel. They shall be located so as not to cause injury to personnel or damage to equipment. The heaters shall be controlled by a hygrostat with a variable humidity and temperature setting. The heaters shall be dimensioned to ensure that condensation cannot occur within the switchgear panel. Heaters of adequate rating shall be provided for the circuit breaker, cable and LV compartments.

The 230V AC supply, for the heaters shall be controlled by a suitably rated single pole miniature circuit Breaker.

cc) The circuit breaker cubicle shall have a limit switch which shall be wired to provide SCADA indications on whether the breaker is fully racked in or fully racked out (withdrawn).

dd) All the switchgear panels shall be rodent and vermin proof.

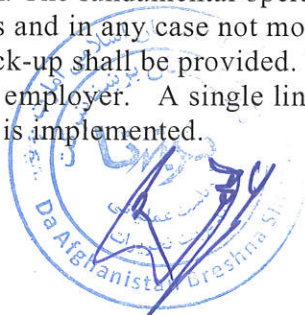
ee) Suitable means shall be provided to monitor the status of the HV cable, i.e., whether it is live or dead. The monitoring device shall be a three phase device with illumination in red color for live status visible from the front of the panel without opening any compartment doors. The indications shall be labeled R, Y & B or L1, L2 & L3. The device shall meet the requirements of IEC 61243-5.

ff) Each switchgear panel shall be provided with Tinned copper earth bar of adequate cross section area to be able to withstand the rated short-circuit current of 25 kA for 3 seconds, and arranged so that the bars of adjacent panels are joined together to form a common earth busbar. Provision shall be made at either end of the assembled switchgear board for connection of the earthing bar to the substation earthing grid.

gg) Manual close & open push buttons shall be provided on the circuit breaker compartment door for manual close and open of the circuit breaker both in the service and in the test (withdrawn) position. The manual close and open push buttons shall be clearly labeled with CLOSE and OPEN Labels and with I (red) and O (Green) Symbols and color codes as per the IEC standard.

hh) The complete switchgear board shall be equipped with ARC protection, consisting of ARC protection relays and arc sensing devices located in the Cable, Circuit Breaker and Busbar Compartment of each panel. Optical sensors shall be used. The sensors shall operate upon occurrence of a flash (light) from the ARC. The sensors shall be connected to the ARC

protection Relays via fiber cables or any other suitable means that is already in use. The ARC protection relay shall monitor both the operation of the Optical sensors and overcurrent relay and shall only operate upon operation of both the sensing device and the pickup of the overcurrent element. It shall also be possible to select the operation of the scheme due to operation of the optical sensor alone but with longer time delay. Upon operation of the ARC Protection, all circuits within the fault Zone shall be tripped by the ARC protection relay. The ARC protection scheme shall have means for indicating the panel and the compartment where the ARC occurred. The scheme shall be secure and immune to mal-operation. The fundamental operating time of the ARC protection scheme shall preferably be 50 ms and in any case not more than 100 ms. however adjustable time delay and overcurrent pick-up shall be provided. The design of the complete scheme shall be to the approval of the employer. A single line drawing shall be enclosed with the bid to show how the scheme is implemented.



2.3.1 CIRCUIT BEAKERS

a) The circuit breaker shall be three pole operated, indoor type, employing Vacuum

Interrupter with air or solid Insulation and shall comply with the requirement of IEC 62271-100 in respect of design, type tests, service operation and the making and breaking of faulty currents.

b) The moving portion of each circuit breaker shall consist of a three-pole circuit breaker, operating mechanism, primary and secondary disconnecting devices, auxiliary switches, position indicators and necessary control wiring. The Auxiliary switches shall be of the plug-in type, with the male contacts mounted on the breaker carriage and the female contacts on the plug-in cable connected to the panel wiring. Other options may be considered where there is adequate proof that the auxiliary contacts will always be making firmly without mis-alignment. Finger contacts will however not be acceptable.

c) The circuit breakers of the same current and voltage ratings shall be fully interchangeable, both electrically and mechanically.

d) Name plate for the circuit breaker shall be provided with all the required details as per IEC standards, including:-

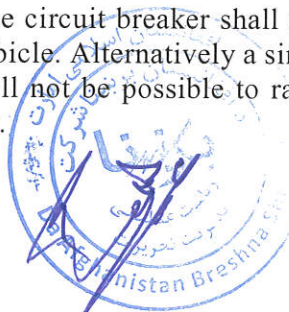
- i) Circuit Breaker Type
- ii) Applicable IEC standard iii) Total Weight
- iv) Rated Voltage
- v) Lightning impulse withstand voltage
- vi) 1 minute Power frequency withstand voltage vii) Rated frequency
- viii) Rated Current
- ix) Breaking Capacity
- x) Short time current xi) Making capacity
- xii) Operating sequence
- xiii) Rated voltage of closing and opening coil
- xiv) Rated voltage of spring charging motor

e) The circuit breaker operating mechanism shall be motor wound spring operated, power closing with electrical release and with provision for hand spring charge.

f) Mechanical indication shall be provided to indicate the state of the spring. This shall be visible without opening the circuit breaker compartment door. Also two pairs of Auxiliary contacts, which are open, when the springs are charged shall be provided for local and supervisory indication.

g) A spare set of 4 normally open and 4 normally closed auxiliary contacts of the circuit breaker shall be provided and shall be wired to a terminal block (box), for connection to SCADA equipment, etc.

h) The control circuits for the circuit breaker shall automatically be connected when inserting the breakers into the cubicle. Alternatively a single plug-in cable for all auxiliary contacts shall be provided. It will not be possible to rack-in the circuit breaker without connecting the plug in cable first.

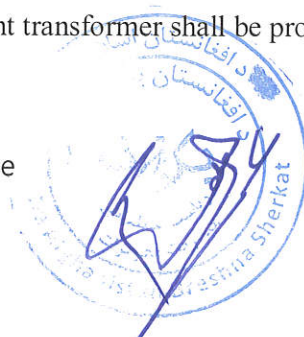


- i) The operating mechanism shall be completely trip free both mechanically and electrically.
- j) The circuit breaker shall have a mechanical operations counter
- k) One mechanical ON/OFF indicator, with inscription "ON" white letters on red background and inscription "OFF" white letters on green background shall be provided for the circuit breaker.
Alternatively approved IEC indications for circuit breaker ON and OFF shall be used.

- m) The breaker controls shall have anti-pumping facilities
- n) Where the Circuit Breaker is used for circuit or busbar integral earthing, the control wiring of the breaker housing should be such that when the breaker is in circuit earth or busbar earth positions it shall only be operated mechanically and not electrically.
- o) Circuit breaker poles between the interrupters and the primary plug-in contacts shall be fully insulated with durable material.
- p) The circuit breaker maintenance and operations manual shall contain clear instructions on the maintenance requirements of the circuit breaker (if any), to prevent switchgear failure in service, due to excessive fault current clearance or any other cause .

2.3.2 CURRENT TRANSFORMERS

- a) Current transformers shall be cast Resin Type and shall be accommodated inside the cubicle, in a separate compartment or in the same compartment as the cable.
- b) The current transformers shall be in accordance with the requirements of IEC 60044-1 and IEC 60044-6 and shall have the specified accuracy under load and short-circuit conditions and shall be able to withstand the effect of short-circuit fault current rating of the switchgear, of 25 kA for 3 seconds.
- c) Current transformers shall have a rated burden as specified, sufficient for the connected Numerical Protection relays and Energy meters and instruments. **The CT rated burden shall however not be less than 15 VA.**
- d) The Manufacturer of the CTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/certificates as per IEC 60044-1 of CTs of similar rating and class verifying the class and accuracy as well as the limits of error for the declared class similar to those of the specified CTs shall be submitted with the bid for tender evaluation purposes. The specified CTs must be within the product range of the manufacturer. A catalogue of the CT manufacturer shall be supplied with the bid.
- e) The current transformer shall have markings on the secondary and primary terminals as per requirements of the IEC 60044-1 standard. The markings shall be indelibly made. The secondary terminals shall have screw terminals.
- f) Name plate for the current transformer shall be provided with all the required details as per IEC 60044-1 Standards, including:-
 - i) The manufacturer's name



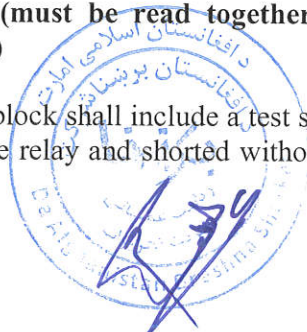
- ii) Serial number and a type designation
- iii) Rated primary and secondary current iv) Rated frequency
- v) Rated output and corresponding accuracy class for each secondary winding, including the rated accuracy limit factor and Instrument security factor for protection and metering secondary windings respectively.
- vi) The highest voltage of the equipment. vii) The rated Insulation level.
- viii) The rated short-time thermal current (I_{th}) and the rated dynamic current. ix) Class of Insulation.
- x) Rated continuous thermal current.

2.3.3 VOLTAGE TRANSFORMERS

- a) The VT shall be of Cast resin, indoor, type mounted within the 20kV incomer panel. The VT shall be three (3) Single phase units.
- b) Voltage transformers shall be suitable for operation of the protection relays, metering and transformer voltage regulating relay and shall be in accordance with the requirement of IEC 60044-2.
- c) Each voltage transformer shall be star/star connected and complete HV links.
- d) The Manufacturer of the VTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per IEC 60044-2, of VTs of similar rating and class as the specified VTs shall be submitted with the tender for evaluation purposes. The Specified VTs must be within the product range of the manufacturer.
- e) Name plate for the voltage transformer shall be provided with all the required details as per IEC60044-2 Standards, including:-
 - i) The manufacturer's name
 - ii) Serial number and a type designation
 - iii) Rated primary and secondary voltage iv) Rated frequency
 - v) Rated output and corresponding accuracy class for each secondary winding,
 - vi) The highest voltage of the equipment
 - vii) The rated Insulation level
 - ix) Class of Insulation for the equipment
 - x) Rated voltage factor and corresponding rated time.
 - xi) The use each secondary winding and its corresponding terminals

2.3.4 PROTECTION RELAYS (must be read together with particular technical specifications control and protection)

- a) The LV compartment terminal block shall include a test switch (block), which enables the CTs circuits to be isolated from the relay and shorted without open circuiting the CT, to



facilitate relay testing in situ and to allow for isolation of VT circuits, alarm and trip circuits without disconnecting wires at the terminal block.

- b) The Measurement relays shall be Flush mounted and of Numeric Design, with event recording, Fault recording, power measurement, and shall be in accordance to IEC 60255.
- c) Besides the communication port, the relays shall have a human - machine interface facility (MMI) with and LCD Screen where one can easily access relay information.
- d) Relay contacts shall be suitable for making and breaking the maximum currents, which they are required to control in normal service. Where contacts of the protective relays are not sufficient for circuit breaker tripping, auxiliary trip relays shall be provided, in order to prevent damage to output contacts of the measuring relay.
- e) Operating time for auxiliary tripping relays shall not significantly affect the overall fault clearance time, i.e., the auxiliary trip relays must have short pick up time of less than 30 ms.
- f) Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by Panel vibration or external magnetic fields.
- g) Relays shall be provided with clearly inscribed labels describing their functions and IEC Device Function numbers. The labels shall be to the approval of the Employer.
- h) Relays shall be suitable for operation on the station D.C. supply without use of dropping resistors or diodes.
- i) To reduce the effect of electrolysis, relay coils operating on DC shall be so connected such that they are not continuously connected from the positive pole of the station battery.
- j) The relay Thermal rating shall be such that the fault clearance times on any combination of current and time multiplier settings shall not exceed the thermal withstand capability of the relay. (Max. fault current = 25 kA).
- k) The relays shall be EMC 89/336/EEC compliant. And communication protocol shall comply with IEC 61850 standard

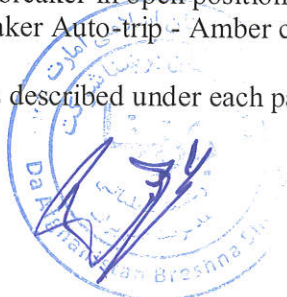
2.3.5 INDICATIONS AND INSTRUMENTS

All instruments shall be flush mounted and shall be in accordance with the requirement of IEC

51. Each cubicle shall have the following indications.

- One indicator lamp to show the breaker in closed position - RED color
- One indicator lamp to show the breaker in open position - GREEN color
- One indicator lamp to show breaker Auto-trip - Amber color

The instruments shall be supplied as described under each panel in the subsequent sections.



LABELLING OF THE SWITCHGEAR PANELS:

NB1: For Each Switchgear Board the panels shall be assigned a distinct numerical number for identification starting with number one (1) on the left hand side. The number will be embedded

on a stainless steel plate of width not less than 5 cm. The size of the number shall be at least 3 cm high. The stainless steel plate shall be fixed to the panel using stainless steel bolts.

2.4 RATINGS OF SWITCHGEAR EQUIPMENTS

a) 20kV Incomer and Feeder Circuit Breakers:

Interrupting Medium	Vacuum
Number of poles	3
Highest equipment Voltage	24kV
One minute power frequency withstand voltage	55 kVrms
Impulse withstand voltage peak (dry)	125kV
Frequency	50 Hz
making current (peak)	62.5kA
Rated Short circuit current withstand	25 kA, 3 Seconds
Operating sequence	O-0.3 sec-CO-3min.-CO
Auxiliary D.C voltage for closing and tripping coils	24V
Auxiliary A.C. voltage	230V AC, 50Hz
Tripping/closing coil auxiliary voltage	110V DC
Spring charging motor supply	230 V AC
Rated normal Current – Incomers	1250 A
Rated normal Current – Feeder	630 A
Rated normal Current – Bus Bar	2500 A

b) Current Transformers for Incomer and Feeder Panels

Ratings:

Rated Short time current (ST) withstand : 25 kA for 3 seconds at Rated Voltage of the CT

Rated maximum continuous current:-

Incomer : 1250 A

Feeder : 630 A

Ratio and class:

i) 20KV Incomer panels.

Core 1: C.T Ratio : 400/800/1 (Turns Ratio)

Class : X

Imag : 0.02 A Vk

Core 2: C.T Ratio : 400/800/1 A

Class : 5P10

Core 3: C.T Ratio : 800/1A



Class : 0.2

- i) 20KV feeder panel
- ii) Core 1: C.T Ratio : 600/300/1/1/1A
Class : 5P10
- Core 2: C.T Ratio : 600/300/1/1/1 A
Class : 0.2

c) Voltage Transformers:

Ratings:

Rated Voltage of the VT 20 KV

Ratio: Core1, Core 2 : 20000/√3:110/√3: 110/√3

VA : 100

Accuracy : 3P&0.2

2.5 FACTORY ACCEPTANCE TESTS (FATs) (see clause 1.20)

All the switchgear panels shall be tested in accordance with the requirement of IEC 60298.

Tests shall be carried out on the circuit breakers as per the requirement of IEC 62271-100.

Current transformers and Voltage transformers shall be tested in accordance with the requirement of IEC 60044-1 and IEC 6044-2 respectively.

The following tests shall be carried out during the FATs, by the manufacturer in presence of the employer's engineers.

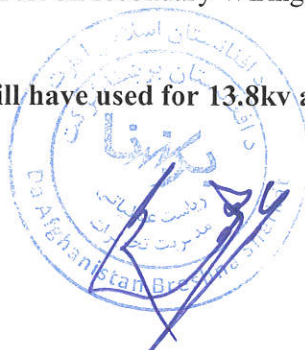
1 Complete Switchgear Board

- a) Dimensional checks
- b) Operational Tests
- c) Primary Injection Tests
- d) calibration Tests on Relays and Instruments Power frequency Withstand Test
- e) Contact resistance test of Primary joints
- f) Lightning Impulse withstand test
- g) Power frequency Withstand Test on secondary Wiring

2) 20 and kV Circuit Breaker which will have used for 13.8kv as well

Routine tests.

- a) Operation test.
- b) High Voltage test, dry.



- c) Voltage tests on controls and auxiliary circuits.
- d) Measurement of resistance of the main circuit.

Type Tests : Submit copies of Type test Reports and Certificate.

- e) Mechanical endurance test
- f) Temperature rise test. g) Impulse voltage test
- h) Interrupting Capacity

NB: Copies of Type Test certificates for similar rated Circuit Breakers and certified by National Standards and Testing Authority body or Reputable Third Party Test Laboratory shall be submitted with the Tender for Evaluation Purposes.

3) Current Transformer

Routine tests shall be carried out at the manufacturer's plant as per the requirement of IEC 60044-1, as listed below, in the presence of project Owner .

- i. Polarity test and verification of terminal markings test
- ii. Ratio and phase angle error test (accuracy class composite error test)
- iii. Power frequency tests on primary and secondary windings
- iv. Power frequency withstand tests between sections (windings)
- v. Inter-turn over voltage tests
- vi. Partial discharge measurement

Certificates and type Test report for the following type tests shall be provided during the FATs:-

- i. Lightning, Impulse voltage withstand test
- ii. Temperature rise test
- iii. Short time current test
- iv. Determination of Errors
- v. Radio Interference voltage measurement (RIV)

4) Voltage Transformer

Routine tests shall be carried out at the manufacturer's plant during FATs as per the requirement of IEC 60044-2, as listed below:-

- (a) Polarity tests and verification of terminals
- (b) Power frequency withstand tests on Primary windings (c) Power frequency withstand tests on secondary windings (d) Power frequency withstand tests between sections
- (e) Determination of errors
- (f) Partial discharges measurement

Certificates and type test report for the following type tests shall be provided during the FATs:-

- (a) Temperature rise test
- (b) Lightning Impulse Test
- (C) Determination of errors
- (d) Short-circuit withstand test capability
- (e) Measurement of the radio interference voltage (RIV)

5. Protection Relay Tests



- a. Relay Pick-up test for all functions and phases b. Relay timing test for all functions and phases

2.7 PROTECTION RELAYS, CONTROLS AND MEASURING DEVICES REQUIREMENTS FOR SWITCHGEAR PANELS

2.7.1 GENERAL REQUIREMENTS

- a) The equipment for the control system shall be highly reliable, long - lived and suitable for continuous operation.
- b) All instrument scales, coils, relay contacts and other features shall be suitable for the apparatus controlled or the purpose intended
- c) It shall be the manufacturer's responsibility to properly design the electrical control, protective relaying, alarm and indication schemes related to the 20 kV switchgear panels.
- a) The Manufacturer shall prepare arrangement and detailed drawings, equipment lists and wiring diagrams based on the requirements for meters, relays, control switches, indicating lamps and other devices including those to be supplied under other subsections
- e) Protection against electrical faults and abnormal conditions on 20 kV switch board and the incoming & outgoing 20kV feeders shall be conducted by the protective relays and associated switchgear

2.7.2.1 FEEDER PANELS REQUIREMENTS

The overhead feeder panels shall be equipped with the following protection relays, measuring and indicating devices, controls and other accessories.

- (i) Feeder protection and control relay. The relay must fully meet the requirements of the detailed specifications included in this specifications.
- (ii) Trip circuit supervision relay visible from front of panel without having to open any panel compartment door. The TCS Relay shall be offered as a separate relay and NOT as a function of the feeder protection relay. Alternatively, the trip circuit supervisory function may be included in the feeder protection and control relay provided that it meets all the requirements of the specifications.
- (iii) Autoreclose ON/OFF mechanical selector switch mounted on the panel and indelibly labeled.
- (v) A single power measurement unit shall be provided for each feeder panel to capture instantaneous and maximum demand values for the following parameters; I, kV, MW, MVAR and p.f.
- (vi) Tariff Energy Meter
- vii) Current Transducer; output 0-20mA, for input current of 0 - 1 Amp
- viii) Circuit breaker control switch (Close, Open & Neutral), with a mechanical Lock
- ix) Circuit Breaker ON (red), OFF (green) and auto-trip (amber) indication lamps
- x) Anti-condensation heaters for the Circuit Breaker and the LV compartment



- xi) Hygrostat with separate humidity and temperature control setting to control the heater.
- xii) DC supply undervoltage relay on the feeder panels at the two ends of the switchgear board when assembled
- xiii) AC supply undervoltage relay on the feeder panels at the two ends of the switchgear board when assembled
- xiv) Door switch operated lighting point and bulb
- xv) 3 Pin - square power socket outlet with red neon indicator
- xvi) Suitably rated MCBs for auxiliary 220V DC for control, 230 V AC for motor, 230 V AC for heaters and illumination and VT 110 V AC supplies shall be fitted

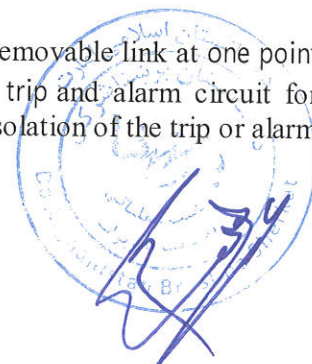
2.7.3 PROTECTION RELAYS

2.7.3.1 REFERENCES

IEC 60255: Electrical Relays

2.7.3.2 GENERAL REQUIREMENTS

- a) The electrical measuring protective relays shall be of Numeric design.
- b) Auxiliary relays, of Static or electromechanical design, with mechanical flag indicators are acceptable.
- c) The protective relays and auxiliary relays shall operate successfully for any value of the DC supply voltage between 85% and 125% of the rated voltage of 110V DC without exceeding the temperature rise limits for the operating coils.
- d) Each Measuring protection relay shall be of the panel flush mounted, back connected, type with rectangular case. Each relay shall have a removable transparent cover or cover with a transparent window making the front of the relay visible. It is preferred that each measuring relay shall be of a withdrawable type from the front of the panel with sliding contacts, without opening the current transformer secondary circuits, disturbing external circuits or requiring disconnection of leads on the rear of the panels.
- e) Each protection relay shall be equipped with adequate electrically independent contacts, of adequate rating for Trip and alarm functions. The relay shall also have adequate number of LEDs to assign each of the available protection functions. The number of LEDs shall not be less than eight (8).
- f) Test facilities for each AC current secondary circuit so as to provide access for testing of the protective relay and its associated circuits. This shall be provided on the terminal block and will consist of isolation links on the current transformer and voltage transformer circuits and suitable terminals for insertion of test leads banana terminals for injection of secondary current and voltage.
- g) Each current transformer circuit shall be earthed through a removable link at one point only in the control compartment's terminal block. The protection trip and alarm circuit for each panel shall be provided with an isolation link to facilitate isolation of the trip or alarm circuit for testing and trouble-shooting of the circuits.



- h) Relays contacts shall be suitable for making and breaking the maximum currents, which they may be required to control in normal service. Where contacts of the protective relays are unable to deal directly with the tripping currents, Auxiliary Trip relays shall be provided. This will ensure safety for the protection relays output contacts.
- i) Relays contacts shall make firmly without bounce and the whole of the relay mechanism shall be as far as possible unaffected by vibration or external magnetic fields.
- j) Relays shall be provided with clearly inscribed labels on the surface of the panel describing their application in words e.g., "Three overcurrent & earth Fault relay" in addition to the IEC numbering.
- k) To minimize the effects of electrolysis, relay coils operating on Dc shall be so connected that the coils are not continuously connected from the positive pole of the battery.
- l) The relay thermal rating should be such that the fault current clearance times on any combination of current and time multiplier setting shall not exceed the thermal withstand capability of the relay (Maximum Fault current= 25 kA).
- m) The numerical relays will be equipped with an RS232 communication port to facilitate connection to a Laptop computer for configuration and parameter setting. Also a communication port shall be provided on each numerical relay for interface into a substation control and monitoring system and for remote interrogation and programming of the protection relays.
- n) The relays will also have an MMI with LCD screen and keypad to facilitate manual relay programming and data access.
- o) Relay operation due to system fault, shall be indicated by a Red L.E.D. and the fault details (flags) shall be displayed on the MMI. Both the relay fault flags and red L.E.D shall be reset via reset push buttons without opening the relay cover.

2.9 DETAILED SPECIFICATIONS FOR RELAYS, MEASURING AND INDICATING INSTRUMENTS, CONTROL SWITCHES AND OTHER ACCESSORIES.

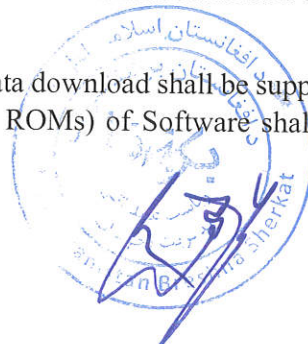
These specifications indicate the required performance characteristics for each of the Protection Relays and are in accordance with IEC 60255.

- a) **The Outgoing Feeder Protection and Control Relay 1:**



This relay shall be installed on the feeder panels and shall as a minimum meet the following requirements.

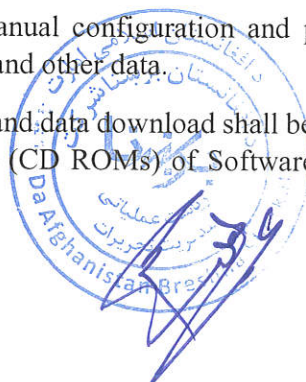
- ☐ The Feeder protection and control relay shall be of numeric design
 - ☐ The Relay will have a large LCD screen measuring at least **7 cm x 7 cm where a mimic of the switchgear arrangement and status of the switchgear for the bay shall be displayed.** The position of the circuit breaker, i.e., racked-in or withdrawn shall be indicated. Circuit breaker close and open key buttons with symbols and color codes as per the IEC standards shall be provided on the relay as well as switchgear selection key. A local/remote key selector switch shall be provided on the relay and the selected status of the selector switch indicated by means of an LED.
 - ☐ The relay shall be equipped with a keypad for manual configuration and parameter settings and for access of settings, fault and event records.
 - ☐ The relay offered shall have at least the following protection functions;- three phase overcurrent and earth fault to be installed in the switchgear panels. Other protection functions include, Autoreclose function, breaker failure protection, antipumping, under and over frequency as well as over and under voltage functions. All the protection functions shall meet the requirements of each function as included in this specifications.
 - ☐ The relay shall monitor, measure and display on the screen the following parameters; I, V, P, Q and p.f. Also the circuit breaker wear shall be monitored and stop red. The relay shall store at least 20 fault records, 20 events and 6 oscillographic fault records.
 - ☐ It shall be possible to display instantaneous measurands on the screen alongside the Bay Mimic.
 - ☐ The unit shall have a green L.E.D to indicate healthy status and a red L.E.D to indicate operation (Trip) of the protection functions.
 - ☐ It shall be equipped with a red L.E.D indicator to indicate relay failure as well as output
 - ☐ The Relay terminals shall be screw type terminals large enough to accommodate at least 4 mm² cable and shall be located at the back of the Relay.
 - ☐ It shall be Equipped with an RS232 serial port for connection to a laptop computer for configuration and setting of relay and control functions and also for access of the relay data.
- Also a communication port for connection to local area network shall be provided. Seven
- (7) Laptop to relay connection cables shall be provided
- ☐ Seven (7) sets of Installation, commissioning, operation and maintenance manuals shall be provided.
 - ☐ Software for relay configuration, parameter settings and data download shall be supplied in CD ROM with the switchgear boards. Four (4) copies (CD ROMs) of Software shall be supplied.



b) The Incomer feeder Protection and Control Relay 2:

This relay shall be installed on the incomer switchgear panels and shall as a minimum meet the following requirements.

- ☐ The feeder protection and control relay shall be of numeric design
- ☐ The relay will have a large LCD screen measuring at least **7cm x 7cm where a mimic of the switchgear arrangement and status of the switchgear for the bay shall be displayed**. The position of the circuit breaker, i.e., racked-in or withdrawn shall be indicated. Circuit Breaker close and open key buttons with symbols and color codes as per the IEC standards shall be provided on the relay as well as switchgear selection key. A local/remote key selector switch shall be provided on the relay and the selected status of the selector switch indicated by means of an LED.
- ☐ The relay offered shall have at least the following protection functions;- three phase overcurrent and earth fault, directional three phase overcurrent and earth fault relay. Other protection functions include breaker failure protection, under and over frequency as well as over and under voltage functions. All the protection functions shall meet the requirements of each function as included in this specifications.
- ☐ The Relay shall monitor, measure and display on the screen the following parameters; I, V, P, Q and p.f. Also the circuit breaker wear shall be monitored and store. The relay shall store at least 20 fault records, 20 events and 6 oscillographic fault records.
- ☐ It shall be possible to display instantaneous measurands on the screen alongside the bay mimic.
- ☐ The unit shall have a green L.E.D to indicate healthy status and a red L.E.D to indicate operation (trip) of the protection functions.
- ☐ It shall be equipped with a red L.E.D Indicator to indicate relay failure as well as output contacts to signal relay failure.
- ☐ The relay shall have at least eight (8) programmable LEDs for displaying protection and other alarms.
- ☐ The relay terminals shall be screw type terminals large enough to accommodate at least 4 mm² cable and shall be located at the back of the relay.
- ☐ It shall be equipped with an RS232 serial port for connection to a laptop computer for configuration and setting of relay and control functions and also for access of the relay data.
- ☐ The relay shall be equipped with a keypad for manual configuration and parameter settings and for access of settings, fault and event records and other data.
- ☐ Software for relay configuration, parameter settings and data download shall be supplied in CD ROM with the switchgear boards. Four (4) copies (CD ROMs) of Software shall be supplied.



NB: The Protection Functions Offered in the feeder protection and control relay shall satisfy the detailed specifications for each of the functions, detailed below:-

(i) Three phase overcurrent and earth fault relay for outgoing feeders

Should incorporate the following Features;

- ☐ Relay must be of Numerical Design
- ☐ Shall be suitable for mounting on the panel front.
- ☐ Current setting range for overcurrent relay $0.5I_n-2.4I_n$
- ☐ Current setting range for earth fault relay $0.05I_n-0.8I_n$
- ☐ I.D.M.T characteristics according to BS142 or IEE255 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
- ☐ Highest Element for both overcurrent and earth fault with.

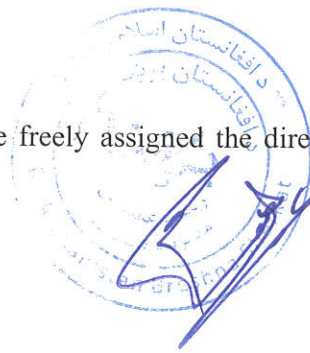
Protection, with a setting range of $1-30I_n$ and a definite time delay setting of 0 - 60 Seconds.

- ☐ Circuit breaker maintenance
- ☐ Fault records and event records
- ☐ Trip and start contacts shall be freely configurable to the output relays.
- ☐ Drop off /pickup ratio $>90\%$
- ☐ Low transient overreach $< 10\%$

(ii) Three- Phase Overcurrent and Earth Fault Relay for incomer

Should incorporate the following Features;

- ☐ Relay must be of Numerical design.
- ☐ Current setting range for overcurrent relay $0.5I_n-2.4I_n$
- ☐ Current setting range for earth fault relay $0.05I_n-0.8I_n$
- ☐ Quadrature connection for polarizing voltage
- ☐ Applicable on the LV side of a Dyn5 transformer
- ☐ High set Element, with a setting range of $1-32I_n$
- ☐ All stages of the phase and earth Fault elements shall be freely assigned the directional feature.



- ☐ Shall have the ability to program the directional feature forward or reverse for each setting stage
- ☐ I.D.M.T characteristics according to BS 142 or IEC 255 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 polarizing voltage at an angle equal to the relay characteristic angle.
- ☐ Time setting multiplier 0.05 - 1.0
- ☐ Highest element for both overcurrent and earth fault protection, with a setting range of 1-20In and a definite time delay setting 0 to 60 Sec.
- ☐ Circuit breaker maintenance
- ☐ Incorporate fault records, event records
- ☐ Configurable output relays with ability to output starting elements to control tripping of other upstream protection relays.

iii) Trip relay

- ☐ High burden tripping relay, immune to capacitance discharge currents and leakage currents
- ☐ At least 7 pairs of outputs contacts two of which should be NC contacts
- ☐ Instantaneous operation, $t < 15\text{ms}$
- ☐ Flag or target shall be a red L.E.D, durable bulb or red mechanical flag
- ☐ The relay shall be suitable for flush mounting
- ☐ The relay shall be electrically reset, the reset button shall be inbuilt on the relay and accessible without opening the relay cover OR shall be supplied separately for panel surface mounting.
- ☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm² cable and shall be located at the back of the relay
- ☐ Relay terminals shall be clearly marked

Relay contacts configuration shall preferably be drawn on the relay casing

(iv) Trip circuit supervision Relay

The relay shall have the following features

- ☐ Continuous supervision of trip circuit for circuit breaker in both OPEN & CLOSED positions
- ☐ Trip circuit fail - Red L.E.D or Flag
- ☐ Trip circuit healthy - green L.E.D or no flag



☐ Suitable for panel surface mounting; However if mounted inside the control compartment, then the relay must be visible from the front.

☐ Two (2) normally closed (Ne) and two (2) normally open (NO) or 2NO/Ne output contacts

☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm² cable and shall be located at the back of the relay

☐ Relay terminals shall be clearly marked

☐ Relay contacts configuration shall preferably be drawn on the relay casing

(v) Annunciator Relay Unit

☐ Shall have Silence, Accept and Reset, push buttons, to control the Alarms

☐ Shall be equipped with at Least 16 separate alarm Elements

☐ Each of the elements shall be freely assigned to one of two common output alarms; urgent and non-urgent alarm.

☐ Each alarm element shall have a red L.E.D. to indicate ON status. It shall also have provision for fixing of identification label changeable on site. A flashing alarm element shall be clearly visible.

☐ The urgent and non-urgent common alarms shall be freely configurable to the output relays.

☐ High immunity against electrical interference.

☐ Relay output for audible alarm and for self supervision shall be provided

☐ Integrated event register to provide analysis of the latest sixteen (16) events

☐ Each of the elements shall be freely assigned to one of two common output Alarms; Urgent and NON-urgent Alarm.

☐ Relay Terminals-shall be screw type terminals large enough to accommodate at least 2.5 mm² cable and shall be located at the back of the relay

☐ Relay terminals shall be clearly marked

☐ Relay contacts configuration shall preferably be drawn on the relay casing

☐ At least two output relays one for urgent and the other for non-urgent alarm

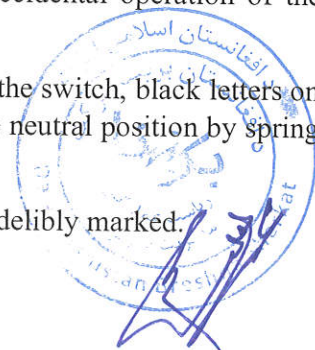
☐ At least two (2) pairs of NO pair of out-put contacts for each out-put relay

(vi) Circuit breaker Close/Open control Switch

☐ The switch shall have a mechanical interlock to prevent accidental operation of the switch.

☐ It shall have a close, neutral and open positions engraved on the switch, black letters on white background. After an operation, the switch shall return to the neutral position by spring action.

☐ The terminals of the switch shall be screw type and shall be indelibly marked.



Auto reclose relay Function in the Feeder Protection Relay.

This autoreclose function shall be housed within the feeder protection relay

- ☐ Selectable 1 - 3 autoreclose shots
- ☐ Independently set dead time for each shot
- ☐ Autoreclose inhibit after manual close
- ☐ Each autoreclose shot shall be initiated by the selected protection function(s).

Operation of protection function not selected to initiate a particular shot of autoreclose shall lead to lock-out of the relay.

- ☐ Autoreclose inhibition for over current high set element.

(vii) Transducers:

a) MW Transducer:

- ☐ Connection shall be 3-Phase, 4-Wire
- ☐ Inputs 110V AC and 1Amp
- ☐ Programmable output characteristic
- ☐ Output shall be 0 - ± 20 mA
- ☐ Auxiliary power supply shall be 230 V Ac and 110V Dc
- ☐ The transducer terminals shall be of screw type, large enough to accommodate 4 mm² cable and shall be indelibly marked.

b) MVAr Transducer:

- ☐ Connection shall be 3-Phase 4-Wire
- ☐ Inputs 110V AC and 1Amp
- ☐ Programmable output characteristic
- ☐ Output shall be 0 - ± 20 mA
- ☐ Auxiliary power supply shall be 230 V AC/ 220 V DC
- ☐ The transducer terminals shall be of screw type, large enough to accommodate 4mm² cable and shall be indelibly marked.

c) Current Transducer:

- ☐ Input 0- 1Amp
- ☐ Output 0 - 20 mA
- ☐ Auxiliary power supply shall be 230 V AC /220 V DC
- ☐ Transducer terminals shall be screw type, large enough to accommodate 4mm² cable and indelibly marked.



d) Voltage Transducer:

- ☐ Input 0- 110 V AC
- ☐ Output 0 - 20 mA
- ☐ Programmable output characteristic
- ☐ Auxiliary power supply shall be 230 V AC, separately connected.
- ☐ Transducer terminals shall be screw type, large enough to accommodate 4mm² cable and indelibly marked.

NB: A single transducer unit with all of the above listed functionality in one casing is acceptable.

(viii) Molded Case Circuit Breakers:

- ☐ Three phase unit with Auxiliary contact
- ☐ Rated operating voltage, 400V AC
- ☐ Rated Insulation voltage 0.6kV / 1kV AC
- ☐ Rated frequency 50 HZ
- ☐ Setting value of thermally delayed Overload release, 3 A
- ☐ Auxiliary switch should have 1 NC & 1 NO contact.
- ☐ Suitable for fixing on a DIN rail
- ☐ Terminals suitable for connection of at least 4 mm² cable

(ix) Signaling Hooter:

- ☐ The actuator system shall consist of a strong, non polarized electromagnet with an impact resistance sturdy casing.
- ☐ Rated frequency 50 HZ.
- ☐ Rated voltage shall be 230V AC; +6/-10 %
- ☐ Protection degree shall be IP 55
- ☐ Operating mode continuous
- ☐ Volume approximately 108 dB (A) 1 ¼ m
- ☐ ~~Hooter terminals shall be large enough to accommodate 4 mm² cable and indelibly marked.~~

(x) Anti-condensation Heater:

- ☐ The heater should be suitable for mounting inside the circuit breaker, the cable and the LV compartment.
- ☐ The Heater for each compartment shall be adequately rated to preventing condensation within the respective compartment.



(xi) DC supply under voltage Relay.

- ☐ Shall have a settable range for under-voltage pick up, of 30-80% of the rated DC voltage
- ☐ Shall be of electromechanical or electronic design
- ☐ Shall have an accuracy of $\leq \pm 4\%$
- ☐ Shall be self reset when the voltage returns to normal level
- ☐ Shall have a built in indication LED (green) and a built in operation LED (red)
- ☐ Shall have at least 2 Ne auxiliary contacts (contacts close for under voltage conditions)
- ☐ The relay shall be rated for continuous operation at the rated DC voltage.
- ☐ Shall be suitable for mounting on DIN rail.
- ☐ Relay terminals shall be screw type, large enough to accommodate 4mm² cable and indelibly marked.

(xii) Indicating Lamps:

- ☐ Shall be suitable for mounting on the front of the panel.
- ☐ The Lamp Indicators should be rated for 110V DC.
- ☐ The lamp indicators should be designed for continuous operation and give a long life of at least 10 Years.
- ☐ The bulb shall be easily replaceable without using a special tool.
- ☐ The Lamp Indicators shall be of LED design.

NB: LED Indicators are preferred

(xiii) Power Measurement Unit:

- ☐ This is a power monitoring meter for panel mounting
- ☐ The unit shall be of numerical design
- ☐ The unit shall have a large LCD display for displaying the measurements
- ☐ The unit shall measure instantaneous values of; rms voltage, both phase - phase and phase to ground, currents, active reactive and apparent power, energy, frequency, power factor and phase angle per phase
- ☐ The unit shall have the following input ratings, 1A and 110V AC phase to phase.
- ☐ The unit shall be for flush mounting on the front of the panel



- ☐ The unit shall be for 3 phase, 4 -wire connection on the secondary of current and voltage transformers
- ☐ The unit shall be equipped with an RS232 port for programming the unit to ensure correct measurement and display of the parameters. The CT and VT ratios shall be programmable.
- ☐ The accuracy of measurement shall be at least class 0.2
- ☐ It shall be possible to display all the measured parameters on the screen through the pre-programmed display screen. The screen to be displayed shall be selectable using the keys on the front of the unit
- ☐ The software and the PC to measurement unit connection cable shall be supplied with the unit.
- ☐ The LCD screen shall be large enough to accommodate at least three measurands simultaneously
- ☐ All the terminals shall be clearly marked
- ☐ The measurement range for power shall at least be up to 20 MVA.
- ☐ The measurement unit terminals shall be screw type, large enough to accommodate 4mm² cable and indelibly marked.

2.10 DETAILED SPECIFICATIONS FOR ENERGY METERS:

SPECIFICATIONS FOR HIGH TENSION (HT) VOLTAGE AND CURRENT TRANSFORMER (CT) CONNECTED STATIC METERS FOR ENERGY METERING ON THE INCOMERS AND FEEDERS.

2.10.2. Requirements

2.10.2.1 Meters shall meet requirements of IEC 62052-11:2003 and IEC 62053-21:2003.

2.10.2.2 Meters shall be suitable for operation in desert climate where temperatures may vary from -1 to +45 degrees Celsius and Average Annual Relative humidity reaching 90% and altitude of up to 2,200m.

2.10.2.3 The meters shall be constructed as 3 phase 4-wire meters but may be wired as 3 phase 4-wire or

3 phase 4-wire meters.



2.10.2.4 The meters shall have terminals with bottom entry for cables and the arrangement shall be

L1V1L1: L2V2L2: L3V3L3: N for 3 phase 4-wire meters.



2.10.2.5 The meters shall conform to the degree of protection **IP 51** as given in **IEC 60529:1989**

Degrees of protection provided by enclosures (IP Code) Amendment 1:1999.

2.10.2.6 The meters **terminal holes** and **screws** shall be made of **brass** or **nickel-plated brass** for high strength and high conductivity. Terminal holes shall be of sufficient size to accommodate the cables of at least 6mm diameter.

2.10.2.7 The meters shall have LED indicators for testing and indication of kWh and kvarh- meter operation.

2.10.2.8 The meters shall be equipped with auxiliary terminals for inputs and outputs.

2.10.2.9 The meters shall have a real-time clock controlled by a quartz crystal oscillator and a backup power supply to run the calendar clock for a minimum of 1 year without mains voltage.

2.10.2.10 The meters shall have a non-volatile memory capable of data storage.

2.10.2.11 The meters shall be capable of storing load profiles for at least **150 days on four channels with 20 minutes** integration for the following parameters namely **Import watts, Export watts, Export VA, Import VA, 4-quadrant Reactive energy Q1, Q2, Q3 & Q4, Phase voltages, Phase currents** and **Power factor**.

2.10.2.12 The meters shall be capable of measuring the following parameters: Active, reactive and apparent energy and demand in export and import modes; Maximum demand in kVA and kW; Four quadrant power measurement; Multi-tariff metering; Accurate measurement for incorrect phase sequence; and Instrumentation data (V, I, Pf, Phase angles, Power etc.).

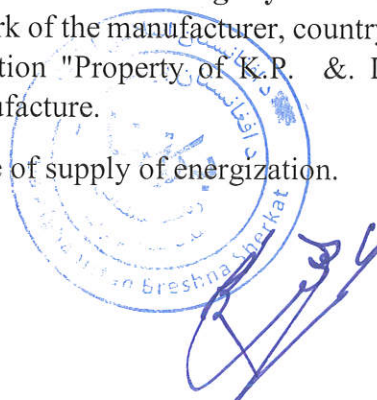
2.10.2.13 **Additional operational and security features of meters:** Meter sealing provisions; Meter software with enhanced access levels; Logging of loss of voltage, over-current, over-voltage, date of last programming; at least 8 and 6 registers for energy and demand respectively; Programmable billing dates; Non resettable billing registers and a minimum of 12 months; LCD with 8 digit ID codes that are EDIS compliant; No mains supply reading facility; RS485 and optical ports for communication; Primary metering for Demand and Energy

2.10.2.14 **Meters rating:** 3 x 63.5/110 V, 3 x 1A and at 50 Hz.

2.10.2.15 **Meter Type and other tests:** Meters to pass tests on Power consumption, Influence of short-time over-currents, Influence of self-heating, Ac voltage test, Limits of errors due to variation of the current, Limits of error due to influence quantities, Test of starting and no-load condition and EME tests.

2.10.2.16 **Name plate marking requirements:** Each meter marked **legibly and indelibly** in English with the following information: Name or trade mark of the manufacturer, country of origin, Type/model, Meter number up to ten digits, the inscription "Property of K.P. & L. Co Ltd, Standard(s) to which the meter complies and Year of manufacture.

2.10.2.17 **Warranty requirements:** 12 months from date of supply of energization.



2.10.2.18 Schedule of Technical data

Standard and type tests	
General requirements, tests and test	IEC 62052-11:2003
Particular requirements for static meters	IEC 62053-21:2003
for Power consumption and voltage	IEC 62053-21:2003
Shock test	IEC 62052-11:2003
Plastic-determination of temperature	IEC 62052-11:2003
Degree of protection	IP51
Measurement Base	Active I Reactive energy, 3 element, 4 quadrant
Network type	3phase 3 or 3 phase 4-wire
Connection type	VT and GT connected
Accuracy	kWh class 0.2
Humidity:	Reaching 90%
Altitude	Up to 2,200m
Temperature range (operating)	-1 to +45 °C
Voltage measurement (Un)	3x 63.5/110 V 50Hz, 3 or 4 wire
Voltage range	0.8 Un to 1.15 Un
Voltage circuit burden	≤2 W and 15 VA
Burst test	4 kV
Impulse voltage	6 kV, 1.2/50 μs
Current measurement	In = 1 A; I _{max} ≥ 6 A
Short circuit current	20 I _{max} for 0.5 s
Starting current	0.001 In
Current circuit burden	≤1 VA
LGD	7 Measurement and 5 ID (EDIS) digits
Load profile	≥180 days -4-channel capacity at 20 minute
Dielectric strength	4 kV, 50 Hz., 1 min.

NB: The bidder should read through the document thoroughly and submit with the bid all the required test certificates, manuals and drawings, etc.

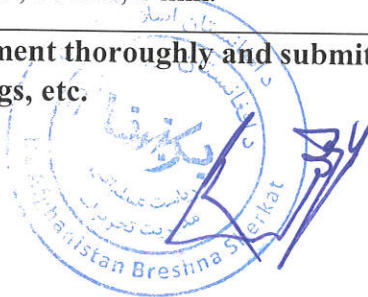


Table: Technical Data for Distribution Transformer 630 kVA, 20/0.4 kV

Manufacturer's Name		To be specified	
Type / Model		Oil-immersed	
Installation		With oil conservator	
Dielectric		outdoor	
Oil type		oil, without PCB	
Rated frequency	Hz	to be specified	
Rated power	kVA	50	
Number of phases		630	
Rated voltage:		3	
- High voltage side	kV	20	
- Low voltage side	kV	0.4	
Taps on HV side	%	±2x2.5%, off load	
Rated currents			
- High voltage side	A	to be specified	
- Low voltage side	A	to be specified	
Impedance voltage	%	6	
Vector group		Dyn5	
Treatment of neutral (LV side)		Solidly earthed	
Losses:			
- No-load	W	To be specified	
- Load	W	To be specified	
Insulation level HV-winding			
Lightning-impulse test voltage	kV	125	
Power-frequency test voltage	kV	50	
Insulation level LV-winding			
Lightning-impulse test voltage	kV	30	
Power-frequency test voltage	kV	10	

Make By:

Reviewed By:

Checked By:

Approved By:



Resistance per phase:			
- HV winding	Ω	to be specified	
- LV winding	Ω	to be specified	
Sound pressure level	dB(A)	52	
Max. temperature rise at 45° C ambient temperature and at full load:			
- Winding	°C	to be specified	
- Iron core	°C	to be specified	
- Oil at top level	°C	to be specified	
Max. ambient temperature	°C	45	
Cooling system		ONAN	
Conductor material			
Insulating material of windings		Copper	
Insulation class		to be specified	
Standard bushings		yes	
Accessories:			
- Dial type contactor thermometer transformer	pcs.	1	
- Oil level indicator	pcs.	1	
- Pocket thermometer	pcs.	1	
- Grounding terminals	pcs.	2	
- Filter pipe	pcs.	1	
- Oil drain plug	pcs.	1	
- Rating plate	pcs.	1	
- Towing eye	pcs.	1	
Weights:			
- Total	kg	to be specified	
- Oil	kg	to be specified	
Dimensions:			
- Length	mm	to be specified	
- Width	mm	to be specified	
- Height	mm	to be specified	
- Distance between wheels centers	mm	to be specified	
Standard specifications		IEC 60076-7 IEC 60354	

Make By:

Reviewed By:

Checked By:

Approved By:

Battery

15.1 Type

The DC Batteries shall be Lead-Acid Plant type and shall be Normal Discharge type. These shall be suitable for a long life under continuous float operations and occasional discharges, the capacity of Battery shall be 12VDC 100AH as per IEC-60896-2 Standard. The common life cycle of a 12-volt lead-acid battery is can take around 350-500 full cycles of being discharged. Type test report might be acceptable. And bidder as responsible to submit type test report with the bid document and specify the vendor.

Technical Data
Sheet

PERFORMANCE SPECIFICATIONS

Voltage per unit	12 Volts		
Cell per unit	6 cells		
Nominal Capacity (10.50 Volts)			
20 hr.	5A / 100Ah		
10 hr.	9.2A / 92Ah		
5 hr.	15.8A / 79Ah		
1 hr.	55.2A / 55.2Ah		
Approximate Weight	66.15 lb / 30.00 kg		
Energy Density	1.86 W-h/in3 (113.45 W-h/l)		
Specific Density	17.65 W-h/lb (38.91 W-h/kg)		
Internal Resistance	(Approx.) 5mΩ		
Max Discharge Current	300A (7 Min.)		
Max Short-Duration Discharge Current	750A (10 Sec.)		
Shelf Life			
1 Month	3 Months	6 Months	12 Months
97%	91%	83%	64%
Operating Temperature Range			
Charge	-4°F (-20°C) to 122°F (50°C)		
Discharge	-40°F (-40°C) to 140°F (60°C)		
Charging Voltage (25°C)			
Cycle Use	14.4-15V(-30mV/°C), Max. Current 20.0A		
Float Use	13.6-13.8V(-20mV/°C)		
Terminal Type	NB		
Certificate	ce,ur		

Battery Racks:

The contractor shall provide Battery racks for Dehrawood As per Specific dimension of 12VDC, 100AH 10Pes batteries for Tow Steps stationary battery racks. To install easy-to-use racks are strong, have a flexible design, and are acid-proof. Their light, small frame makes them easy to install Batteries.



Battery Charger (Rectifier)

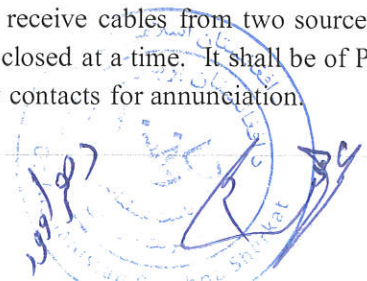
The battery chargers shall comply with IEC 60146.

The DC system for 110 VDC is unearthed. The Battery Chargers as well as their automatic regulators shall be of static type. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. float charging the associated Lead-Acid Batteries at 2.13 to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at the desired rate. Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and facility shall be provided for wirings up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.

1. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within +1% of the set value, for AC input voltage variation of +10%, frequency variation of +5%, a combined voltage and frequency variation of +10%, and a DC load variation from zero to full load.
2. All battery chargers shall have constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.
3. All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.
4. Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for charging mode.
5. During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.
6. The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for Boost Charging mode.
7. The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.
8. Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

MCCB

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.



Rectifier Transformer

The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

Rectifier Assembly

The rectifier assembly shall be fully/half-controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

Instruments

One AC voltmeter and one AC ammeter along with selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy classes. In addition to the above a center zero voltmeter with selector switch shall also be provided for 110 V chargers for testing purpose.

Air Break Switches

One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. 'ON' and 'OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCB's of suitable ratings shall also acceptable in place of Air Break Switch.

Fuses

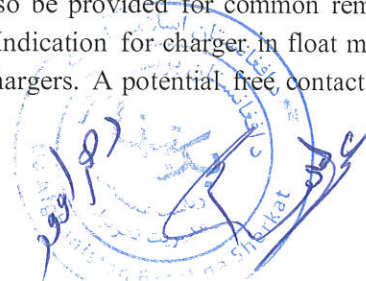
All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. The Bidder depending on the circuit requirement shall choose fuse rating. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

Blocking Diode

Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.

Annunciation System

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities: a) AC power failure b) Rectifier/chargers fuse blown. c) Over voltage across the battery when boost charging. d) Abnormal voltage (High/Low) e) any other annunciation if required. Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in Owner's Control Board. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.



Name Plates and Marking

The name plates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipment's and ease of operation and maintenance.

Charger Construction

The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be suitable for lugs and drilling of gland plates. The Charger shall be tropicalized and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-21 as per relevant international standard

1. All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.
2. Each Charger shall be furnished completely wired up to power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq. mm. Stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq. mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.
3. The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

Painting

All sheet steel work shall be pre-treated, in tanks, in accordance with relevant international standard. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be 'Class-C' as specified in relevant international standard. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint as per relevant international standard shall be applied, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.



Item	Da Afghanistan Breshna Sherkat (DABS) Dehrawood.			
- No.	Schedule of Technical Data	Unit	Required	Offered Data
1.3.1	Battery chargers (Rectifier)			
	Applicable standard	IEC	60146	
	Manufacturer		To be Specified	
	Type		Indoor	
	Type of controls		tyristor	
	Type of cooling		Self-ventilating	
	Rated voltage primary	V	400	
	Rated voltage secondary	DCV	110+-20%	
	Rated current at 400V, 50Hz	A	31.6	
	Output Current	A	50	
	IP protection	IP	21	
	Operation Temperature	°C	0 to 40	
	Mounted in metal cabinet		yes	
	Charging characteristics		To be Specified	
	Constant voltage range	V	To be Specified	
	Continuous charging voltage per cell and tolerances	V +/-	To be Specified	
	Mode of operation		To be Specified	
	Noise level	d(B)A	To be Specified	
	Charger Efficiency		≥ 91%	
	Main dimensions Height x Width x depth	mm	To be Specified	
	Weight	kg	To be Specified	



Table : LOW VOLTAGE MCCB – 1000 A FOR OUTGOING FEEDER

Description	Unit	Required	Offered
Manufacturer	-	<i>To be specified</i>	
MCCB: rated current	A	1000	
Rated continues current	A	1000	
Trip unit	A	1000	
Ultimate breaking capacity	kA	>50	
Short circuit current	kA	28.1	
Rated operation voltage	V	415- 690	
Frequency	Hz	50	
Rated insulating voltage	V	800	
Temperature rang	C ⁰	-5 to +40	
Rated impulse voltage	KV	8	
Pole quantity	pole	3	
Standard	-	IEC 60947.2	

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Table : LOW VOLTAGE MCCB – 100 A FOR OUTGOING FEEDER

Description	Unit	Required	Offered
Manufacturer	-	<i>To be specified</i>	
type		<i>indoor</i>	
MCCB: rated current	A	100	
Rated continues current	A	100	
Trip unit	A	100	
Ultimate breaking capacity	kA	>25	
Short circuit current	kA	2.28	
Rated operation voltage	V	415- 690	
Frequency	Hz	50	
Rated insulating voltage	V	800	
Temperature rang	C ⁰	-5 to +40	
Rated impulse voltage	KV	8	
Pole quantity	pole	3	
Standard	-	IEC 60947.2	

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Table: LOW VOLTAGE MCCB – 63 A FOR OUTGOING FEEDER

Description	Unit	Required	Offered
Manufacturer	-	<i>To be specified</i>	
MCCB: rated current	A	63	
Rated continues current	A	63	
Trip unit	A	63	
Ultimate breaking capacity	kA	>25	
Short circuit current	kA	1.43	
Rated operation voltage	V	415- 690	
Frequency	Hz	50	
Rated insulating voltage	V	800	
Temperature rang	C ⁰	-5 to +40	
Rated impulse voltage	KV	6	
Pole quantity	pole	3	
Standard	-	IEC 60947.2	

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Table: LOW VOLTAGE MCCB – 25 A FOR OUTGOING FEEDER

Description	Unit	Required	Offered
Manufacturer	-	<i>To be specified</i>	
MCCB: rated current	A	25	
Rated continues current	A	25	
Trip unit	A	25	
Ultimate breaking capacity	kA	>25	
Short circuit current	kA	1.43	
Rated operation voltage	V	415- 690	
Frequency	Hz	50	
Rated insulating voltage	V	800	
Temperature rang	C ⁰	-5 to +40	
Rated impulse voltage	KV	6	
Pole quantity	pole	3	
Standard	-	IEC 60947.2	

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Table: LOW VOLTAGE MCCB – 16 A FOR OUTGOING FEEDER

Description	Unit	Required	Offered
Manufacturer	-	<i>To be specified</i>	
MCCB: rated current	A	16	
Rated continues current	A	16	
Trip unit	A	16	
Ultimate breaking capacity	kA	>25	
Short circuit current	kA	1.43	
Rated operation voltage	V	415- 690	
Frequency	Hz	50	
Rated insulating voltage	V	800	
Temperature rang	C ⁰	-5 to +40	
Rated impulse voltage	KV	6	
Pole quantity	pole	3	
Standard	-	IEC 60947.2	

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Technical specification for 15MVA 13.8/20Kv Power Transformer

Technical Data Sheet for 15MVA-13.8/20KV Transformer.

Item	Description/Details	Unit	Specified
1	Transformer 13.8/20KV		
1.1	Copper Windings (Pri/Sec)		Dyn11
1.2	Type		2 Winding
1.3	Rated power	MVA	15
1.4	Rated voltage, primary winding	KV	13.8
1.5	Rated voltage, secondary winding	KV	20
1.6	Number required		1
1.7	Load losses at rated voltage and power	kW	To be Specified
1.8	Impedance voltage	%	As per IEC standards
1.9	Maximum Magnetic flux density	Tesla	1.55 or as per standards
1.10	Top oil temperature	°C	55
1.11	Hot spot / winding	°C	60
1.12	Impulse withstand voltage, primary winding	KV	125
1.13	Cooling Type		ONAF
1.14	Impulse withstand voltage, secondary winding	KV	As per standards
1.15	Power frequency withstand voltage, primary winding	KV	50 or as per standards
1.16	Power frequency withstand voltage, secondary winding	KV	50
1.17	Vector Group		Dyn11
1.18	Number of Phases		3
1.19	Frequency	Hz	50
1.20	Frequency Variation		To be Specified
1.21	Transformer neutral earthing		Solidly Earthing
2	On-load tap changer (OLTC) (13.8/20KV)		

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2.1	Maker's type test and reference		IEC 60214 and IEC 60542
2.2	Rated Current	A	As per required / as per MVA and Voltage
2.3	Number of steps		-8, cenral tap, +8
2.4	Contact life (operations)		>200,000 or as per standards
2.5	Taps		$\pm 1.25\%$ Each
3	Bushings – Primary		
3.1	Type		IEC 60137
3.2	Lightning impulse level	KV	As per standards of IEC
3.3	Minimum creep age distance	mm/KV	25
4	Bushings – Secondary		
4.1	Type		IEC 60137
4.2	Lightning impulse level	KV	As per standards of IEC
4.3	Minimum creepage distance	mm/KV	25
4.4	Windings		Copper

Type Tests

The following type tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Temperature rise test
- Zero sequence impedance
- Noise level
- Examination of harmonics
- Tests on bushings

Routine Tests

The following routine tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Winding resistance measurements on all windings
- Ratio tests on the rated voltage connection
- Polarity tests
- No-load loss at 90%, 100% and 110% of rated voltage
- Exciting current at 90%, 100% and 110% of rated voltage
- Impedance and load loss at rated current
- Separate source withstand tests
- Induced voltage tests



- Impulse voltage withstand tests on all windings. Full wave and chopped wave
- Pressure tests on tank and coolers for oil tightness. If a temperature test is made, the pressure test shall
- be made while the transformer is still hot
- Operational tests of all devices and wiring
- Insulation tests on auxiliary devices and wiring
- Test on bushings

Losses in Transformer

The losses shall be stated and guaranteed in the Bid schedules. The capitalized value of the guaranteed losses will be taken into account when comparing Bids and will be added to the Bid price. The losses will be capitalized at the rates as follow:

- No load loss: US\$ 6,500 per kilowatt
- Load loss: US\$ 1,500 per kilowatt applied to the total transformer capacity proposed by the Bidder. The guaranteed losses are to be maximum values and shall not be exceeded. If the tested losses exceed the guaranteed losses but are within the tolerances allowed in IEC 60076 then losses in excess of the guarantees shall be capitalized at the evaluation rate and the amount deducted from the contract price. There will be no credit for losses under guarantee. The values for losses stated by the Contractor in the Bid Documents shall be verified during the factory tests. The Employer has the right to reject transformers that exceed the tolerances allowed by IEC 60076.

Note: All the necessary accessories including Protection relay, Fittings and associated equipment of 15MVA 13.8/20kV Power Transformer shall be considered based on IEC standard.



Table: MV Underground Cable 12/20 kV, N2XS2Y 1 x 185 RM/25

Designation	Unit	Required	Offered
Manufacturer's name		To be specified	
Type		N2XS2Y	
Conductor material and form		Copper / Circ. Stranded	
Nominal cross section of conductor	mm ²	185	
Nominal cross section of screen	mm ²	25	
Insulation material of conductor		XLPE	
Insulation thickness	mm	5.5	
Outer sheath material		PE	
Thickness of outer sheath	mm	2.5	
Overall diameter of cable (D)	mm	38.5	
Weight of cable	Kg/km	2,650	
Minimum bending radius	mm	15 D	
Nominal voltage	kV	12/20	
Service voltage actual (future)	kV	15 (20)	
Frequency	Hz	50	
Effective a.c. resistance at 90° C	Ω/km	0.132	
Operating capacitance	μF/km	0.273	
Max. admissible short circuit current (1s) of conductor (screen)	kA	26.5	
<u>Installation in ground</u>			
Current carrying capacity	A	462	
Ohmic losses per cable	KW/km	To be specified	
Inductance per conductor	mH/km	0.377	
Standards		IEC 60502 IEC 60228 DIN VDE 0273 HD 620	

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Table: Technical data for 12/20kv Cable Termination- Outdoor

Designation	Unit	Required	Offered
Cable			
Nominal voltage of cable	kV	12/20	
Cable type		N2XS2Y	
Insulation material of conductor		XLPE	
Outer sheath material	mm2	PE	
Nominal cross-section	mm2	35	
Nominal cross-section	mm2	50	
Nominal cross-section	mm2	70	
Nominal cross-section	mm2	95	
Nominal cross-section	mm2	120	
Nominal cross-section	mm2	150	
Nominal cross-section	mm2	185	
Nominal cross-section	mm2	240	
Termination			
Manufacturer		to be specified	
Type		to be specified	
Design		track resistant, silicon rubber insulator with an detector for controlling the electrical field	
Installation	kV	>55	
Rated lightning – impulse test voltage	kV	>145	
Rated power – frequency withstand voltage		>U ₀	
Direct current withstand	kA	>75	
Short-time current withstand	mm	to be specified	
Dimension	kg	to be specified	
Weitht			
Standard specifcactions		IEC 60, 230, 437, 502 VDE 0278	

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Table: Technical data for 12/20kv Cable Termination- indoor

Designation	Unit	Required	Offered
Cable			
Nominal voltage of cable	kV	12/20	
Cable type		N2XS2Y	
Insulation material of conductor		XLPE	
Outer sheath material		PE	
Nominal cross-section	mm ²	35	
Nominal cross-section	mm ²	50	
Nominal cross-section	mm ²	70	
Nominal cross-section	mm ²	95	
Nominal cross-section	mm ²	120	
Nominal cross-section	mm ²	150	
Nominal cross-section	mm ²	185	
Nominal cross-section	mm ²	240	
Termination			
Manufacturer		to be specified	
Type		to be specified	
Design		track resistant, silicon rubber insulator with an detector for controlling the electrical field	
Installation	kV		
Rated lightning – impulse test voltage	kV	>55	
Rated power – frequency withstand voltage		>145	
Direct current withstand	kA	>U ₀	
Short-time current withstand	mm	>75	
Dimension	kg	to be specified	
Weightht		to be specified	
Standard specifications		IEC 60, 230, 437, 502	
		VDE 0278	

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