



Standard Technical Specifications for Electrical Works

POWER COMPENSATION

(Data Sheets)

11kV Capacitor Banks

FEWA STANDARD : D-POC-CAP-11 (Rev.0-2010)



POWER COMPENSATION 11kV Capacitor Banks

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
1.00	<u>GENERAL</u>	
1.01	Manufacturer of complete Capacitor Bank	
1.01.1	name	
1.01.2	country of manufacturer	
1.02	Applicable standards	IEC 71-1, 2, 3, 4 60060-1 60549 IEEE Std. 18-2002 IEEE Std. 1036 IEEE Std. C37.19.00
1.03	Type test	
1.03.1	carried out	yes
1.03.2	date	dd-mm-yy
1.03.3	testing laboratory	
1.03.3.1	name	
1.03.3.2	country	
1.04	Maximum audible sound level at 2m distance	dB(A) 50
1.05	Type	
1.06	Commercial operation time of offered capacitor bank type	years
2.00	<u>CONSTRUCTION DATA</u>	
A.	<u>Capacitor Unit</u>	
2.01	Manufacturer	
2.01.1	name	
2.01.2	country of manufacturing	
2.02	Applicable standards	IEC 60871-1 60871-4
2.03	Type test	
2.03.1	carried out	yes
2.03.2	date	dd-mm-yy

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11kV Capacitor Banks

SI. No.	REQUIRED	TENDERED
2.03.3	testing laboratory	
2.03.3.1	name	
2.03.3.2	country	
2.04	Type	
2.05	Number of capacitors (elements)	
2.05.1	series	No.
2.05.2	parallel	No.
2.05.3	total	No.
2.06	Number of bushings	No. 2
2.07	Type of connector provided at capacitor unit terminals	
2.08	Type of internal fuse	
2.09	Minimum No. of elements in each unit	Min. 40
2.10	Impregnant	
2.10.1	applicable standards	
2.10.2	impregnating medium	non-PCB
2.10.3	brand name	
2.10.4	specification reference	
2.11	Container	
2.11.1	material	
2.11.1.1	type	stainless steel
2.11.1.2	grade	
2.11.1.3	thickness	mm
2.11.1.4	degree of protection	IP
2.11.2	minimum rupturing pressure of container	kg/mm ²
2.11.3	dimension	
2.11.3.1	length	mm
2.11.3.2	width	mm
2.11.3.3	height	mm
2.12	Discharge resistor (built-in)	yes

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**POWER COMPENSATION
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Sl. No.	REQUIRED	TENDERED
2.12.1	type	
2.13	Total weight of complete unit capacitor including all fitting and impregnating medium kg	
2.14	Commercial operation time of offered capacitor u years * approximate data will be finalised at detailed engineering stage	
B.	<u>Capacitor Unit Bushings</u>	
2.15	Manufacturer	
2.15.1	name	
2.15.2	country of manufacturing	
2.16	Applicable standards IEC 60137	
2.17	Type test	
2.17.1	carried out yes	
2.17.2	date dd-mm-yy	
2.17.3	testing laboratory	
2.17.3.1	name	
2.17.3.2	country	
2.18	Type	
2.19	Catalogue number	
2.20	Material composite	
2.21	Creepage distance mm/kV 31	
2.22	Commercial operation time of offered unit bushings years	
C.	<u>Series Reactors</u> as per requirement specified in standard	
D.	<u>Contactor</u>	
2.23	Manufacturer	
2.23.1	name	
2.23.2	country of manufacturing	
2.24	Applicable standards IEC 60265-1 + 60470	

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
2.25	Type test	
2.25.1	carried out	yes
2.25.2	date	dd-mm-yy
2.25.3	testing laboratory	
2.25.3.1	name	
2.25.3.2	country	
2.26	Type	
2.27	Catalogue number	
2.28	Interrupting medium	
2.28.1	vacuum	yes/no
2.29	Auxiliary contacts	
2.29.1	normally open (NO) when contactor is closed	No. 4
2.29.2	normally close (NC) when contactor is closed	No. 4
2.30	Operating mechanism power consumption	
2.30.1	closing (d.c.)	W
2.30.2	holding (d.c.)	W
2.30.3	tripping (d.c.)	W
2.31	Position indicator	yes
2.32	Commercial operation time of offered contactor	years
E.	<u>External Capacitor Stage HRC Fuses</u>	
2.33	Manufacturer	
2.33.1	name	
2.33.2	country of manufacturing	
2.34	Applicable standards	IEC for capacitor bank +60282
2.35	Type test	
2.35.1	carried out	yes
2.35.2	date	dd-mm-yy
2.35.3	testing laboratory	
2.35.3.1	name	

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
2.35.3.2	country	
2.36	Type	
2.37	Catalogue number	
2.38	Visual indicating when blown	yes
2.39	Weight	kg
2.40	Commercial operation time of offered fuses	years
F.	<u>Capacitor Racks</u>	
2.41	Number of racks	No.
2.42	Number of capacitor units connected in parallel per phase	No.
2.43	Mounting of capacitor units	
2.43.1	horizontal	yes/no
2.43.2	vertical	yes/no
2.44	Center line between capacitor units	mm
2.45	Dimension	
2.45.1	length	mm
2.45.2	width	mm
2.45.3	height	mm
2.46	Center line between capacitor racks	mm
G.	<u>Surge Arresters</u>	as per requirement specified in standard
H.	<u>Isolator / Grounding Switch (3-Position)</u>	
2.47	Manufacturer	
2.47.1	name	
2.47.2	country of manufacturing	
2.48	Applicable standards	IEC 60129
2.49	Operating facilities	
2.49.1	hand	yes

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**POWER COMPENSATION
11kV Capacitor Banks**

SI. No.	REQUIRED	TENDERED
2.49.2	motor	yes
2.50	Auxiliary switch contacts	
2.50.1	normally open (NO) when isolator is closed	No. 4
2.50.2	normally close (NC) when isolator is closed	No. 4
2.51	Dimension	
2.51.1	length	mm
2.51.2	width	mm
2.51.3	height	mm
2.52	Weight	kg
2.53	Commercial operation time of offered isolator / grounding switch	years
I.	<u>Capacitor Bank Feeder Circuit Breaker</u>	as per requirement specified in standard
J.	<u>Post Insulators</u>	
2.54	Manufacturer	
2.54.1	name	
2.54.2	country of manufacturing	
2.55	Applicable standards	IEC
2.56	Type test	
2.56.1	carried out	yes
2.56.2	date	dd-mm-yy
2.56.3	testing laboratory	
2.56.3.1	name	
2.56.3.2	country	
2.57	Type	
2.58	Catalogue number	
2.59	Material	composite
2.60	Creepage distance	

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
2.60.1	Installations in indoor housing (IP 43) mm/kV 42	
2.60.2	Installations in outddor housing (IP 54) mm/kV 31	
2.61	Strength	
2.61.1	cantilever N	
2.61.2	tensile N	
2.61.3	compression N	
2.63	Weight kg	
2.64	Commercial operation time of offered post insulators years	
K.	<u>Current Transformers</u> as per requirement specified in standard	
L.	<u>Capacitor Bank Housing for outdoor type (if applicable)</u>	
2.65	Manufacturer	
2.65.1	name	
2.65.2	country of manufacturing	
2.66	Applicable standards IEC	
2.67	Construction material details	
2.67.1	base plate / corner posts	
2.67.1.1	material hot-dip galvanised steel sheet	
2.67.1.2	minimum thickness mm 3	
2.67.2	walls / doors	
2.67.2.1	material ALU-ZINC	
2.67.2.2	applicable standards BS 729	
2.67.2.3	minimum thickness mm 2	
2.67.2.4	K-value W/m^2 0.56	
2.67.3	roof (double sheet)	
2.67.3.1	upper and lower side	
2.67.3.1.1	material ALU-ZINC	

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POWER COMPENSATION
11kV Capacitor Banks

Sl. No.	REQUIRED	TENDERED
2.67.3.1.2	applicable standards BS 729	
2.67.3.1.3	minimum thickness mm 2	
2.67.3.1.4	K-value $W/m^2 \cdot K$ 0.41	
2.67.4	partitions (if applicable)	
2.67.4.1	material ALU-ZINC	
2.67.4.2	applicable standards BS	
2.67.4.3	minimum thickness mm	
2.68	Protection against accumulation of water on roof	yes
2.69	Degree of protection	
2.69.1	switchgear compartment IP 54 - Outdoor, 43 - Indoor	
2.70	Lighting	
2.70.1	normal	
2.70.1.1	type bulk head	
2.70.1.2	number No. 1	
2.70.1.3	power W 100	
2.70.1.4	voltage V_{ac} 240	
2.70.1.5	MCB protection	yes
2.70.1.6	door switch provided	yes
2.71	Sockets	yes
2.71.1	single-phase	
2.71.1.1	type	
2.71.1.2	number No. 1	
2.71.1.3	voltage v 240	
2.72	Vermin proof	yes/no
2.73	Access doors for each compartment	yes
2.74	Door stopper at all doors	
2.74.1	gas-spring type	yes/no
2.75	Door fixings to fix the door panel during maintenance	yes

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Sl. No.	REQUIRED	TENDERED
2.76	Corrosion protection details	
2.76.1	material powder paint polymer resin base	
2.76.2	outside	
2.76.2.1	type	
2.76.2.2	minimum thickness	µm 100
2.76.2.3	color	RAL 7032
2.76.3	inside	
2.76.3.1	type	
2.76.3.2	minimum thickness	µm 40
2.76.3.3	color	RAL
2.77	Earthing arrangement	
2.77.1	earthing bar	
2.77.1.1	material	copper
2.77.1.2	minimum cross-section	mm ² 240
2.77.1.3	dimension	
2.77.1.3.1	width	
2.77.1.3.2	height	
2.77.2	interconnection between compartments, etc.	
2.77.2.1	material	stranded copper conductor
2.77.2.2	minimum cross-section	mm ² 70
2.77.3	number of connections for external earthing	No. 2
2.77.4	copper rods at housing	
2.77.5	external earthing devices	
2.77.5.1	material	copper rods
2.77.5.1.1	minimum number	No. 2
2.77.5.1.2	cross-section of each copper rod	mm ²
2.78	Danger sign details (at each housing door)	
2.78.1	material	stainless steel
2.78.1.1	grade	1.4301 (V2A)

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SI. No.	REQUIRED	TENDERED
2.78.2	width mm	
2.78.3	height mm	
2.78.4	letters	
2.78.4.1	quality of paint sun light proof, no fading	
2.78.4.2	height of letters mm 100	
2.78.5	colors	
2.78.5.1	background	
2.78.5.2	letters red	
2.78.6	fixing bolts	
2.78.6.1	material stainless steel	
2.78.6.1.1	grade 1.4301 (V2A)	
2.78.7	numbers No.	
2.79	Identification sign details (at housing)	
2.79.1	material stainless steel	
2.79.1.1	grade 1.4301 (V2A)	
2.79.2	width mm	
2.79.3	height mm	
2.79.4	letters	
2.79.4.1	quality of paint sun light proof, no fading	
2.79.4.2	height of letters mm 100	
2.79.5	colors	
2.79.5.1	background	
2.79.5.2	letters red	
2.79.6	fixing bolts	
2.79.6.1	material stainless steel	
2.79.6.1.1	grade 1.4301 (V2A)	
2.79.7	numbers No. 1	
2.80	Lifting devices details	
2.80.1	housing	
2.80.1.1	number 4	
2.80.2	roof	
2.80.2.1	number 4	

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POWER COMPENSATION
11kV Capacitor Banks

Sl. No.	REQUIRED	TENDERED
2.81	Cable protection	yes
2.81.1	11 kV underground cable protection box	yes
2.82	Stainless steel used for handles, hinges, signs, bolts, nuts, etc.	
2.82.1	grade	1.4301 (V2A)
N.	<u>Wiring</u>	
2.83	Material stranded copper wires for cross-sections >2.5mm ² else solid copper wires	copper
2.84	Cross-sections	
2.84.1	power circuits (min)	mm ² 1.5
2.84.2	control circuits	mm ² 1.0
2.84.3	CT circuits (min)	mm ² 2.5
2.84.4	VT circuits (min)	mm ² 1.5
2.84.5	other wiring	mm ² 1.5
3.00	<u>ELECTRICAL DATA</u>	
A.	<u>Common for the Capacitor Bank</u>	
3.01	Rated voltage	kV 12
3.02	Permissible overvoltage (continuous)	% 1.1 x U _{rated}
3.03	Nominal operating voltage	kV 11
3.04	Rated current	A
3.05	Permissible continuous current	% 1.3 x I _{rated}
3.06	Rated output at 40°C ambient temperature	MVA _r 3 x 1.2
3.07	Permissible maximum output	% 135
3.08	Frequency	Hz 50
3.09	Lightning impulse withstand voltage	
3.09.1	indoor type	kV _{peak} 75
3.09.2	outdoor type	kV _{peak} 95
3.10	Power frequency withstand test voltage	kV _{rms} 38
	# suitable for 12kV maximum system voltage	
	* stage contactors and fuses are rated 12kV	

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11kV Capacitor Banks

Sl. No.	REQUIRED	TENDERED
3.11	Rated short-circuit current kA/3se 31.5	
3.12	Rated reactance (per phase) Ω	
3.13	Nominal capacitance μF	
3.14	Maximum permitted tolerance (%) %	
3.15	Maximum dielectric stress permitted by the design for capacitor bank	
3.16	Total losses kW	
3.17	Variation of losses due to temperature variation over an ambient temperature range from 0°C to +50°C Dwg No.	
3.18	Variation of capacitance due to temperature variation over an ambient temperature range from 0°C to +50°C Dwg No.	
3.19	Self inductance of mH	
3.20	Control circuits voltage V_{dc} 110	
3.21	Auxiliary circuits rated voltage V_{ac} 230/400	
B.	<u>Busbars</u>	
3.22	Rated current carrying capacity at max. 50°C A	
	Rated current carrying capacity at 40°C A	
C.	<u>Capacitor Units</u>	
3.23	Rated current A	
3.24	Rated output kVAr	
3.25	Nominal capacitance μF	
3.26	Maximum permitted tolerance (%) %	
3.27	Maximum dielectric stress permitted by the design	
3.28	Insulation level of each unit capacitor	
3.28.1	lightning impulse level kV	
3.28.1.1	outdoor kV_{peak} 95	
3.28.1.2	indoor kV_{peak} 75	
3.28.2	power frequency withstand voltage kV 38	
3.29	Total losses W	
3.30	Variation of losses due to temperature variation over an ambient temperature range from 0°C to +50°C Dwg. No.	

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
3.31	Variation of capacitance due to temperature variation over an ambient temperature range from 0°C to +50°C Dwg. No.	
3.32	Maximum surface temperature of unit capacitor container °C	
3.33	Internal temperature of unit capacitor	
3.33.1	mean °C	
3.33.2	max hot spot °C	
3.34	Self inductance of mH	
3.35	Natural frequency of unit capacitor kHz	
3.36	Resistance of discharge resistor kΩ	
3.37	Time required for capacitor-unit internal discharge devices alone (without the aid of external discharge paths) to discharge the capacitor per phase voltage from rated voltage to 75 V minute: <10	
3.38	Tolerance of rated capacity at rated V and Hz % of rated KVAR	
3.39	Max. operating capacity % of rated KVAR	
3.40	Max. operating voltage (including harmonics) % of rated KVAR	
3.41	Max. operating current (including harmonics) % of rated KVAR	
D.	<u>Capacitor Unit Bushings</u>	
3.42	Impulse withstand voltage	
3.43	Power frequency withstand voltage	
3.43.1	dry kV _{1min}	
3.43.2	wet kV _{10s}	
E.	<u>Series Reactors (de-tuning)</u> as per requirement specified in standard	
F.	<u>Contactor</u>	
3.44	Rated voltage kV 12	
3.45	Operating voltage kV 11	

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11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
3.46	Rated current at 40°C	A
3.47	Rated current at 50°C	A
3.48	Rated breaking current capacity	kA
3.49	Breaking time	mS
3.50	Closing time	mS
3.50.1	number of switchings	
3.50.1.1	with rated current	No. 100,000
3.50.1.2	with rated short circuit breaking current	No. 100
3.51	Rated supply voltage of operating mechanism	
3.51.1	coil	V _{dc} 110
3.51.1.1	allowable variation of voltage	±%
3.51.1.2	power consumption at normal voltage	W
3.52	Auxiliary switches	
3.52.1	rated voltage	V _{ac} 230
G.	<u>External Capacitor Unit Fuses</u>	
3.53	Rated current of the fuse link	A
3.54	Max. continuous current capability of the fuse link	A
3.55	Rated capacity breaking current	A
3.56	Rated inductive breaking current	A
3.57	Max. I ² t values which the fuse can withstand for:	
3.57.1	5 discharges	
3.57.2	100 discharges	
3.58	Max. available capacitor energy which the fuse can withstand at 1.5 times of rated voltage without bursting	kJ
3.59	Minimum pre-arcing I ² t (under substantially adiabate conditions)	
3.60	Maximum total clearing I ² t	
3.60.1	inductive power frequency current	
3.60.2	capacitive power frequency current	
3.61	Cold resistance of the fuse link	

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**POWER COMPENSATION
11kV Capacitor Banks**

SI. No.	REQUIRED	TENDERED
3.61.1	tolerances	
3.62	Time-current characteristic curve attached	yes
H.	<u>Surge Arresters</u>	as per requirement specified in standard
I.	<u>Isolator / grounding switch (3-position)</u>	
3.63	Remote operation	yes
3.63.1	closing time with motor drive	s
3.63.2	opening time with motor drive	s
3.64	Motor drive	
3.64.1	power	W
3.64.2	rated voltage	V _{dc} 110
J.	<u>Post Insulators</u>	
3.65	Critical-Impulse flashover, positive	kV _{crest}
3.66	Power frequency withstand voltage	kV _{rms}
K.	<u>Wiring</u>	
3.67	Power frequency withstand voltage	kV _{ac-1m} 3
L.	<u>Voltage and Current Transformers</u>	as per requirement specified in standard
M.	<u>Capacitor Bank Feeder Circuit Breaker</u>	as per requirement specified in standard
4.00	<u>CONTROL & PROTECTION</u>	
A.	<u>Common Features of numerical devices</u>	as per requirement specified in standard

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**POWER COMPENSATION
11kV Capacitor Banks**

SI. No.	REQUIRED	TENDERED
B.	<u>Reactive Power Regulator</u>	
4.01	Manufacturer	
4.01.1	name	
4.01.2	country of manufacturing	
4.02	Applicable standards	IEC
4.03	Type	numerical
4.04	Type number	
4.05	Type test	
4.05.1	carried out	yes/no
4.05.2	date	dd-mm-yy
4.05.3	testing laboratory	
4.05.3.1	name	
4.05.3.2	country	
4.06	Technical Data	
4.06.1	Rated Current	A 1
4.06.2	Rated Frequency	Hz 50
4.06.3	Supply Voltage	V DC 110
4.06.4	Scan Rate	kHz
4.06.5	Regulation steps	min 4
4.06.6	Setting Range	cos phi
4.06.7	Memory Capacity	kB RAM
4.06.8	Over Compensation Monitoring	yes
4.06.9	Manual Mode	yes
4.06.10	Self Monitoring	yes
4.06.11	Solternal Interface	RS232
4.06.12	Connection to SCMS	yes
4.06.13	Type of Protocol to SCMS	IEC
C.	<u>Unbalance Protection Relay</u>	

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**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
4.07	Manufacturer	
4.07.1	name	
4.07.2	country of manufacturing	
4.08	Applicable standards	IEC
4.09	Type	numerical
4.10	Type number	
4.11	Type test	
4.11.1	carried out	yes/no
4.11.2	date	dd- mm-
4.11.3	testing laboratory	
4.11.3.1	name	
4.11.3.2	country	
4.12	Technical Data	
4.12.1	DC Infeed	
4.12.1.1	rated voltage	110
4.12.1.2	DC/DC converter included	yes
4.12.1.3	allowable tolerances	+10/-15
4.12.1.4	power consumption	
4.12.2	Rated current	1
4.12.3	Protection class of relay housing	52
4.12.4	Settings	
4.12.4.1	unbalance current range	A
4.12.4.2	number of stages	2
4.12.4.3	accuracy	
4.12.5	Overload limit of unbalance input	A
4.12.6	Operation delay	
4.12.7	Output contact rating	
4.12.7.1	continuous current	A
4.12.7.2	making current	A
4.12.7.3	breaking current	A

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Sl. No.	REQUIRED	TENDERED
4.12.8	Solternal Interface RS232	
4.12.9	Connection to SCMS yes	
4.12.10	Type of Protocol to SCMS IEC	
D.	<u>Thermal Overload Protection Relay</u>	
4.13	Manufacturer	
4.13.1	name	
4.13.2	country of manufacturing	
4.14	Applicable standards IEC	
4.15	Type numerical	
4.16	Type number	
4.17	Type test	
4.17.1	carried out yes/no	
4.17.2	date dd-mm-yy	
4.17.3	testing laboratory	
4.17.3.1	name	
4.17.3.2	country	
4.18	Technical Data	
4.18.1	DC Infeed	
4.18.1.1	rated voltage 110	
4.18.1.2	DC/DC converter included yes	
4.18.1.3	allowable tolerances +10/-15	
4.18.1.4	power consumption	
4.18.2	Rated current 1	
4.18.3	Protection class of relay housing 52	
4.19	Settings	
4.19.1	setting range A	
4.19.2	number of stages required 2	
4.19.3	operating time	
E.	<u>Over / Under Voltage Relay</u>	

TENDERER`S STAMP SIGNATURE



**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
4.20	Manufacturer	
4.20.1	name	
4.20.2	country of manufacturing	
4.21	Applicable standards	IEC
4.22	Type	numerical
4.23	Type number	
4.24	Type test	
4.24.1	carried out	yes/no
4.24.2	date	dd-mm-yy
4.24.3	testing laboratory	
4.24.3.1	name	
4.24.3.2	country	
4.25	Technical Data	
4.25.1	DC Infeed	
4.25.1.1	rated voltage	110
4.25.1.2	DC/DC converter included	yes
4.25.1.3	allowable tolerances	+10/-15
4.25.1.4	power consumption	
4.25.2	Protection class of relay housing	52
4.26	Settings	
4.26.1	setting range	+/-V
4.26.2	operating time	
4.26.3	No. of stages required	2
4.26.4	Solternal Interface	RS232
4.26.5	Connection to SCMS	yes
4.26.6	Type of Protocol to SCMS	IEC
F.	<u>Overcurrent / Earthfault Relay</u>	as per requirement specified in standard
G.	<u>Control / Protection Cubicles</u>	as per requirement

TENDERER`S STAMP SIGNATURE



**POWER COMPENSATION
11kV Capacitor Banks**

Sl. No.	REQUIRED	TENDERED
5.00	<u>TESTS</u>	
	as per IEC-60871 (1-4)	
5.01	Capacitor Unit	
5.01.1	routine tests	2.25 U _{rated}
5.01.2	Insulation resistance	yes
5.01.3	thermal stability test	yes
6.00	<u>LOSSES</u>	
6.01	Guaranteed steady-state loss of capacitor bank at 25 ⁰ C ambient temperature	
6.01.1	Dielectric losses	W/kVar
6.01.2	Discharge resistor losses	W/kVar
7.00	<u>SUPPORTING DOCUMENTS</u>	
7.01	Type test reports enclosed ?	yes
7.02	List of minimum testing facilities enclosed ?	yes
7.03	Technical literature enclosed ?	yes
7.04	Relevant drawing enclosed ?	yes
7.05	Quality assurance plan (QAP) enclosed ?	yes

* Notes:

Parameterisation of CPR1 protection relays and BLR CM06 PF controller is available from SCMS workstation via MODBUS RTU/TCP Gateway.

Recording of control and protection events of the capacitor bank is available to SCMS via volt free signals converted to IEC 61850 communication protocol via BCU/ RTU /I-O box

TENDERER`S STAMP SIGNATURE