Islamic Republic of Iran
Vice Presidency for Strategic Planning and Supervision

General Technical Specification and Execution Procedures for Transmission and Subtransmission Networks Shunt Capacitors of High Voltage Substations

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Description **PAGE**

Technical Specification of Shunt Capacitors

1- General Requirements

This technical specification covers the minimum requirements for the design, manufacturing, and testing of capacitor banks and its components such as fuses, structures, reactors, current transformer, voltage transformer, supporting insulators and all accessories required for proper operation.

Each capacitor bank shall be switched on and off via a circuit breaker which is located in metal clad switchgear.

They shall be designed, manufactured, tested, packed and marked according to the latest edition of all relevant IEC standard publications which are listed hereunder, unless otherwise mentioned in this specification.

- IEC 60871: Shunt capacitors for AC power system having a rated voltage above 1000V
- IEC 60110: Power capacitor for induction heating installation
- IEC 60549: High voltage fuses for the external protection of shunt power capacitors
- IEC 60282-2: High voltage fuses- part2: expulsion fuses
- IEC 60289: Reactors
- IEC 60044-1: Current transformer
- IEC 60044-2: Voltage transformer
- IEC 62155: Hollow pressurized and unpressurized and glass insulators for use in electrical equipment with rated voltage greater than 1000V.
- IEC 60137: Insulated bushings for alternating voltages above 1000V.
- IEC 60168: Tests on indoor and outdoor post insulators of ceramic material or glass for system with nominal voltages greater than 1000V.

All amendments, supplements and reference publications listed within the above standards shall also apply.

The capacitors shall be mounted on the structure and suitable for outdoor installation.

The capacitor units, with other components and connections, and as well as the material used in the construction of them shall be suitable for use in under the specified service conditions.

2- Design and Construction

2-1- Capacitor unit

Required capacitors shall be made by dielectric consisting of several thin layers from plastic film or oriented poly- propylene film (or equal qualified materials), impregnated with an insulating fluid with electrodes in the form of thin aluminum foils.

Unit and bank capacitors shall be capable of withstanding wind, earthquake and external short circuit on the terminals of the live capacitor unit or capacitor bank.

Each capacitor bank units shall be so that unbalance caused by their capacitance tolerance is negligible.

Thermal class shall be clearly marked on each capacitor. All external metal parts appropriated for painting such as capacitor units casing (container) shall be adequately cleaned and painted with one primer and two finish coats of oil and weather resistant paint.

In design of capacitor unit container, adequate provisions shall be considered for assured installation with taking into consideration of method of installation of capacitor units.

Suitable mounting bracket and facilities for lifting by hand and crane shall be considered for each capacitor unit.

Rated voltage of capacitor shall not be less than the maximum operation voltage of power system connected to, with considering the effect of capacitor. In the cases the reactors is series with capacitors, rated voltage of capacitors shall increase because of increment of applied voltage in capacitor terminals.

2-2- Internal fuses

Throughout the life of the capacitor, the fuses shall be capable of carrying continuously a current equal to or greater than the maximum permissible unit current divided by the number of parallel fused paths.

The fuses shall be capable of withstanding inrush currents due to the switching operations expected during the life of the capacitor.

The fuses connected to the undamaged elements shall be able to carry the discharge currents due to the breakdown of elements and also shall be able to carry the currents due to short circuit faults on the bank external to the unit(s) occurring within the voltage range $0.8\sqrt{2}U_N < U < 2\sqrt{2}U_N$.

When the instantaneous disconnection of faulty elements obtained with internal fuses, no sustained arcing can take place in the capacitor unit. The internal fuses shall be well proven designed so that, adjacent elements and fuses shall not be affected by the fuse operation.

Container of capacitor unit shall withstand against over pressure by the gases released in the arc instantaneous disconnection of faulty elements obtained with internal fuses.

2-3- External fuses

An expulsion type external fuse shall be provided for each unit in capacitor banks with parallel capacitor units as well. Meanwhile in capacitor banks with series capacitor units considering an external fuse enough.

The fuse must be chosen with sufficient margin to avoid unjustified tripping due to overvoltages, overcurrents or switching transient.

External fuses must withstand discharge energy from parallel capacitors without exploding.

2-4- Series reactors

If supplied reactor is not fully shielded magnetically for inrush current limitation in capacitor bank, adequate provisions shall be considered for minimizing undue heating of adjacent metallic parts or dangerous forces on adjacent magnetic parts during short circuit. Necessary calculation shall be submitted to verify these requirements.

The reactor of each capacitor bank shall be mounted on the combination of supporting insulators and steel structures.

The reactor terminals shall have the same material main coil and equipped with suitable connector in appropriated size for connection to capacitor bank and circuit breaker.

2-5- Protection relay

The operation of any relay in capacitor protection system, except for voltage relays, should initiate the lockout relay.

The phase and ground over current relays should be restraint against closing inrush current of the capacitor bank.

The unbalance relay which sensed the current passing through joint stars neutral points, should be harmonic restrained. This relay should have two stage of operation, one for alarm and one for trip command.

2-6- Supporting post insulators and bushings

Post supporting insulators and bushing shall be porcelain type. The porcelain shall be manufactured of homogeneous structure free from laminations, cavities or other flaws affecting its mechanical and electrical strength and be suitable for desired operation. It shall be verified and non-porous and shall have a brown-colored glaze. The porcelain of each insulator unit shall be reasonable free from warp and shall be impervious to moisture.

Fittings and accessories made of malleable steel shall be hot dip galvanized.

Portland cement shall be used between the porcelain and metal parts.

The insulators shall be designed to minimize radio interference.

The insulators shall be suitable for use at the elevation and the ambient temperatures and worst case of loading conditions.

Post supporting insulators shall be mechanically dimensioned for stress arising from ice, wind, short circuit and earthquake forces. Besides, post insulators shall be designed so that can be used in upright or horizontally situations as required.

2-7- Steel structure

Steel structure design shall be such as to keep the number of different parts as few as possible to facilitate transport, erection and inspection.

Before galvanizing, parts shall be free from any roughness and burs, with smooth edges. The steel be thoroughly cleaned of paint, grease, rust or any other material.

After galvanizing, punching, drilling, welding or any work which may damage the protective cover will not be allowed.
Steel structures or combination of steel structures and supporting insulator for each capacitor units bank shall be individually provided.
All materials should be so that water and moisture does not ingress. Also in design of the bank's structures shall be taken into consideration wind load, ice loading, short circuit loading, earthquake and its weight.

2-8- Other requirements

Each capacitor unit shall be adequately equipped with parallel resistors in order that discharging or reducing the residual voltage from an initial peak value to 75 V or less for 10 minutes after the capacitor units is disconnected from the source of supply.
Suitable temporary earthing devices shall be supplied for safety purpose during maintenance works when the capacitor bank to be disconnected.
Automatic electromechanical locks for the gate of capacitor units banks yard shall be so considered that entering of personnel to be avoided when the bank is energized, and meantime the mentioned lock shall be opened with adjustable delaying time for 1 to 30 minutes after opening the feeder bank's circuit breaker.

2-9- Marking of units

2-9-1- Nameplate

The following information shall be given on the nameplate of each capacitor unit:

- Manufacturer
- Identification number and manufacturing year (the year may be a part of identification number or be in code form)
- Rated output Q_N in kVAR. For three phase units the total output shall be given
- Rated voltage U_N in V or kV
- Rated frequency in Hz
- Temperature category
- Discharge device, if internal, shall be indicated by wording or by the symbol —□— or by the rated ohmic value
- Insulation level U_i in kV (only for units having all terminals insulated from the container)

The insulation level shall be marked by means of two numbers separated by a stroke, the first number giving the r.m.s. value of the power frequency test voltage, in kV, and the second number giving the peak value of the impulse test voltage, in kV, for example 50/125.

- Connection symbol. All capacitors, except single phase having one capacitance only, shall have their connection indicated.
- Internal fuses, if included, shall be indicated by wording or by the symbol  .
- Chemical or trade name of impregnant (This indication shall be stated on the warning plate).
- Applied standard plus year of issue

Note: On request of the purchaser, the measured capacitance should be indicated either in absolute value, or in percentage, or by symbols.

2-9-2- Warning plate

If the capacitor unit contains material which may pollute the environmental or may be hazardous in any other way, the unit shall be equipped with a label according to the relevant laws of the country of the user. The purchaser shall inform the manufacturer about such law(s).

2-10- Marking of the bank

2-10-1- Instruction sheet or nameplate

The following minimum information shall be given by the manufacturer in an instruction sheet or alternatively on request of the purchaser on a nameplate:

- Manufacturer
- Rated output Q_N in MVAR (total output to be given)
- Rated voltage U_N in kV
- Insulation level U_i. The insulation level shall be marked by means of two numbers separated by a stroke, the first number giving the r.m.s. value of the rated power frequency voltage in kV and the second number giving the peak value of the rated lightning impulse withstand voltage in kV.
- Connection symbol
- Minimum time required between disconnection and reclosure of the bank
- Time to discharge to 75V
- Related symbol to demonstrate the connection method

2-10-2- Warning plate

Subclause 2-9-2 is also valid for the bank.

3- Tests

3-1- Routine tests

- Capacitance measurement
- Measurement of the tangent of loss angle of the capacitor ($\tan\delta$)
- Voltage test between terminals
- AC voltage test between terminals and container
- Test of internal discharge device
- Sealing test
- Discharge test on internal fuses

The internal fuses shall be able to withstand all above routine tests of capacitor unit.

3-2- Type tests

- Thermal stability test
- Measurement of the tangent of the loss angle of the capacitor ($\tan\delta$) at elevated temperature
- AC voltage test between terminals and container
- Lightning impulse voltage test between terminals and container
- Short circuit discharge test
- Test of an external fuse in combination with a capacitor
- Disconnecting test on internal fuse

The internal fuses shall be able to withstand all above type tests of capacitor unit.

4- Drawing and documents

4-1- Documents to be given by tenderer

- Filled schedule CAP (II)
- Catalogue and technical pamphlets
- Summary report of type tests
- Outline drawings
- Detailed summary of exceptions to tender specifications
- Reference list

- Special tools list
- Spare part list

4-2- Documents to be given by contractor / supplier

The electrical and mechanical design, fabrication, factory testing, marking, packing, transportations, warehousing, erection and site testing, operating and maintenance drawings, documents and manuals shall be submitted not limited to the followings:

- Calculation sheets to establish adequacy of capacitor in any respect
- Minimum design calculation list
- Details of steel structures or combination of supporting insulators and steel structures for capacitor bank, reactor, surge arresters, current transformer and voltage transformer
- Layout drawings or equipment arrangements, showing physical dimensions, weights, part numbers with part lists, recommended clearances, fixing and mounting details, electrical ratings, connection and conductors sizes, etc.
- Factory test procedures, schedules and values
- List of equipments and tools
- List of drawings
- Type tests reports
- Instruction manual for storage, erection, operation and maintenance
- Packing details
- Final as built documents and drawings
- Assemble, dismantle and adjusting instructions

5- Commissioning

After installation of shunt capacitors and all connections, commissioning tests are recommended to be performed to confirm that transportation and storage have not damaged the capacitor.

5-1- Primitive inspection

- Visual inspection of insulators, capacitor units and reactors
- Visual inspection of phase terminal connection and structure
- Visual inspection of earthing connection conductor to structure
- Visual inspection of oil leakage

5-2- Commissioning test

- Measurement of capacitance of capacitor unit
- Test of command circuit and operation control and necessary regulation
- Measurement of neutral current and regulation
- Measurement of insulation loss ($\tan\delta$)
- HVDC test

SCHEDULE CAP (I)
RATING AND CHRACTERISTICS OF CAPACITOR BANKS

ITEM	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
1	**Particular of systems**		
1.1	Nominal system voltage	kV	20/33
1.2	Highest system voltage	kV	24/36
1.3	Nominal system frequency	Hz	50
1.4	Type of system neutral grounding		Non effectively earthed
1.5	Rated short circuit current in capacitor unit place	kA_{rms}	*
1.6	Number of phases		3
2	**Service condition**		
2.1	Max. ambient temperature	°C	40/45/50/55
2.2	Min. ambient temperature	°C	-25/-30/-35/-40
2.3	Max. value of daily temperature	°C	*
2.4	Altitude above sea level	m	1000/1500/2000/2500
2.5	Relative humidity	%	90/95/more than 95
2.6	Seismic acceleration	g	0.2/0.25/0.3/0.35
2.7	Pollution level		Low/medium/high/ very high/special
2.8	Max. wind velocity	m/s	30/40/45
2.9	Wind velocity in ice condition	m/s	20
2.10	Ice coating thickness	mm	5 / 10 / 20 / 25
3	**Capacitor**		
3.1	Rated voltage	kV	$20/\sqrt{3}$
3.2	Insulation level:		
3.2.1	Power frequency	kV_{rms}	50 / 70
3.2.2	Lightning impulse	kV_{peak}	125 / 170
3.3	Rated capacity of unit	kVAR	100/125/150/200/250/300/400
3.4	Rated capacity of capacitor bank	kVAR	Depends on necessity and bank's arrangement
3.5	Method of fuse protection (Internal/External fuse)		Internal / External
3.6	Bank’s arrangement type (single star with external fuse/ single star with internal fuse/ double star with external fuse/ double star with internal fuse)		*
3.7	Capacitor units considering with bushing (One bushing/ Two bushings)		One /Two bushings

SCHEDULE CAP (I)
RATING AND CHRACTERISTICS OF CAPACITOR BANKS

ITEM	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
3.8	Type of protection for capacitor bank:		
3.8.1	O/C protection	Yes/No	Yes
3.8.2	O/L protection	Yes/No	Yes
3.8.3	E/F protection	Yes/No	Yes
3.8.4	O/V protection	Yes/No	Yes
3.8.5	U/V protection	Yes/No	Yes
3.8.6	Un balance Protection	Yes/No	Yes
3.9	Discharging resistor	Yes/No	Yes
3.10	Thermal class	°C	Depends on service condition of installation place
3.11	Bushing of unit capacitors:		
3.11.1	Material		Porcelain
3.11.2	Rated one minute power frequency withstand voltage	kV_{rms}	50/70
3.11.3	Rated lightning impulse voltage at site condition	kV_{peak}	125/170
3.11.4	Min. creepage distance	mm/kV	*
4	**Series Reactor**		
4.1	One phase or three phase		One phase
4.2	Type of core		Air core
4.3	Insulation level (at site conditions):		
4.3.1	One min. power frequency withstand voltage of post insulator	kV_{rms}	50/70
4.3.2	Lightning impulse	kV_{peak}	125/170
4.4	Inductance	mH	*
4.5	Continuous rated current (in site condition)	A_{rms}	*
5	**Current Transformer**		
5.1	Class		Outdoor
5.2	Type		Dry type
5.3	Rated insulation levels (at site conditions):		
5.3.1	One min. power frequency withstand voltage	kV_{rms}	50/70
5.3.2	Lightning impulse	kV_{peak}	125/170
5.4	Rated primary current	A_{rms}	2×75/2×150/2×250

SCHEDULE CAP (I)
RATING AND CHRACTERISTICS OF CAPACITOR BANKS

ITEM	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
5.5	Rated secondary current	A_{rms}	1/5
5.6	Rated short time current	kA_{rms}	*
5.7	Rated dynamic current	kA_{peak}	2.5 I_{sc}
5.8	Rated continuous thermal current (% of rated primary current)		100%
5.9	Number of secondary cores		2
5.10	Accuracy class (protection/measurement)		0.5/5P
5.11	Burden	VA	15/30
5.12	Creepage distance	mm/kV	*
5.13	Type of mounting		Mounted on structure
5.14	Neutral CT specification		*
6	**Voltage transformer**		
6.1	Class		Outdoor
6.2	Type		Dry type
6.3	Rated primary voltage	kV	20/33
6.4	Rated secondary voltage	V	100/110
6.5	Rated insulation level in standard condition:		
6.5.1	One min. power frequency withstand voltage	kV_{rms}	50/70
6.5.2	Lightning impulse	kV_{peak}	125/170
6.6	Number of secondary cores		1
6.7	Accuracy class		0.5+3P
6.8	Rated output	VA	50
6.9	Type of outer insulation		Porcelain/ resin insulator
6.10	Creepage distance	mm/kV	*
6.11	Type of mounting		On metal structure
6.12	Neutral PT specification		*
7	**Over voltage relay**		
7.1	Rated DC voltage	V	110/125
7.2	Rated AC voltage	V_{rms}	100/110
7.3	Setting range of voltage		90% to 130% Un, continues
7.4	Number of phases		Connected between two phases
7.5	Time characteristic		Inverse characteristic

SCHEDULE CAP (I)
RATING AND CHRACTERISTICS OF CAPACITOR BANKS

ITEM	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
8	**Zero voltage relay**		
8.1	Rated DC voltage	V	110/125
8.2	Rated AC voltage	V_{rms}	100/110
8.3	Setting range of voltage		20% to 90% Un, continues
8.4	Number of phases		Connected between two phases
8.5	Time setting		0.2 sec. to 9.9 sec.
9	**Over current relay**		
9.1	Rated DC voltage	V	110/125
9.2	Rated AC voltage	V_{rms}	5
9.3	Setting range of current (Inverse)		0.5 to 2.5 In
9.4	Setting range of current (Instantaneous)		3 Is and more
9.5	Number of phases		2 phase
10	**Earth fault relay**		
10.1	Rated DC voltage	V	110/125
10.2	Rated AC current	A_{rms}	5
10.3	Setting range of current (Inverse)		0.2 to 1.0 In
10.4	Setting range of current (Instantaneous)		3 Is and more
11	**Unbalance protection relay (for double stars capacitor banks)**		
11.1	Rated DC voltage	V	110/125
11.2	Rated AC current	Arms	1 / 5
11.3	Setting range of current (First stage)	A	0.2 to 1.0 / 0.5 to 2.0 / 2.0 to 5.0
11.4	Time setting range (First stage)	sec	0.0 to 3.0
11.5	Setting range of current (Second stage of any)	A	0.2 to 1.0 / 0.5 to 2.0 / 2.0 to 5.0
11.6	Time setting range (Second stage)	sec	0.0 to 3.0
12	**Unbalance protection relay (for single stars capacitor banks)**		
12.1	Rated DC voltage	V	110/125
12.2	Rated AC current	V	100/110
12.3	Setting range of voltage (First stage)	V	*
12.4	Time setting range (First stage)	sec	0.0 to 3.0
12.5	Setting range of voltage (Second stage if any)	V	*
12.6	Time setting range (Second stage)	sec	0.0 to 3.0

SCHEDULE CAP (I)
RATING AND CHRACTERISTICS OF CAPACITOR BANKS

ITEM	DESCRIPTION	UNIT	TECHNICAL PARTICULARS
13	**Tripping relays**		
13.1	Rated DC voltage	V	110/125
13.2	Resetting type		Hand reset
13.3	Number of contacts		At least two N.O. and one N.C.
13.4	Contact rating:		
13.4.1	Breaking		10 A for L / R=<40 ms
13.4.2	Operating time		=<20 msec
14	**Time delay relays**		
14.1	Rated DC voltage	V	110/125
14.2	Time setting range	sec	0.02 to 0.99 / 1.0 to 99
14.3	Number of contacts		At least two

* These will be specified by engineer.

SCHEDULE CAP (II)

GUARANTEED TECHNICAL INFORMATION OF CAPACITOR BANKS (TO BE SUPPLIED BY TENDER)

ITEM	DESCRIPTION		TECHNICAL PARTICULARS
1	**Service condition**		
1.1	Max. ambient temperature in design	°C	
1.2	Min. ambient temperature in design	°C	
1.3	Max. value of daily temperature in design	°C	
1.4	Altitude above sea level in design	m	
1.5	Pollution level		
1.6	Max. allowable ice thickness	mm	
1.7	Seismic acceleration	m/s^2	
1.8	Max. wind velocity	m/s	
1.9	Max. wind velocity in ice condition	m/s	
1.10	Relative humidity	%	
2	**Capacitors**		
2.1	Manufacturer's name and country		
2.2	Applicable standard		
2.3	Type of capacitor		
2.4	No. of capacitors in parallel for each unit		
2.5	No. of capacitors in series for each unit		
2.6	Assigned rated current:		
2.6.1	For each unit	A_{rms}	
2.6.2	For each bank	A_{rms}	
2.7	Assigned rated voltage:		
2.7.1	For each element	kV_{rms}	
2.7.2	For each unit	kV_{rms}	
2.7.3	For each bank	kV_{rms}	
2.8	Temperature category range	^0C	
2.9	Variation in capacitance due to temp. variation (percent with respect to value at reference ambient temperature):		
2.9.1	At lowest ambient temp.	%	
2.9.2	At upper limit of ambient temp.	%	
2.10	Element construction:		
2.10.1	Electrode		
2.10.2	Dielectric		
2.10.3	Impregnant		

SCHEDULE CAP (II)
GUARANTEED TECHNICAL INFORMATION OF CAPACITOR BANKS (TO BE SUPPLIED BY TENDER)

ITEM	DESCRIPTION		TECHNICAL PARTICULARS
2.11	Dielectric strength at rated voltage:		
2.11.1	Minimum dielectric strength	kV/mm	
2.11.2	Max. stress	kV/mm	
2.12	Number of units in series or parallel per phase		
2.13	Details of internal fusing arrangement	Yes/No	
2.14	Rated reactive power:		
2.14.1	For each element	kVAR	
2.14.2	For each unit	kVAR	
2.14.3	For each bank	kVAR	
2.15	Total losses at reference ambient temperature and rated voltage and frequency:		
2.15.1	For each element	W	
2.15.2	For each unit	W	
2.15.3	For each bank	W	
2.16	Total losses at upper limit ambient temp. and rated voltage and frequency:		
2.16.1	For each element	W	
2.16.2	For each unit	W	
2.16.3	For each bank	W	
2.17	Tangent losses angle		
2.18	Max. permissible long duration over voltage	kV_{rms}	
2.19	Max. temporary over voltage and duration	kV_{rms}/sec	
2.20	Max. permissible inrush current	kA_{rms}	
2.21	Insulation level between terminal and container		
2.21.1	Power frequency	kV_{rms}	
2.21.2	Lightning impulse	kV_{peak}	
2.22	Resistance of built in discharge resistor	kΩ	
2.23	Temperature rise for container hottest point above ambient at rated power	^0C	
2.24	Temperature rise at rated power	^0C	
2.25	Voltage test:		
2.25.1	Between terminal	kV_{rms}	
2.25.2	Between terminal and container	kV_{rms}	
2.26	Weight of each capacitor unit	kg	
2.27	Number of bushing		

SCHEDULE CAP (II)
GUARANTEED TECHNICAL INFORMATION OF CAPACITOR BANKS (TO BE SUPPLIED BY TENDER)

ITEM	DESCRIPTION		TECHNICAL PARTICULARS
2.28	Dimension of each capacitor unit		
2.28.1	With bushing	mm	
2.28.2	Without bushing	mm	
2.29	Thickness of container body		
2.30	External insulators (bushings):		
2.30.1	Type & manufacturer		
2.30.2	Creepage distance	mm	
2.30.3	Max. permissible forces on the HV terminal	kN	
2.30.4	One minute power frequency (Dry/wet)	kV_{rms}	
3	**External fuses**		
3.1	Type		
3.2	Manufacturer's name and country		
3.3	Applicable standards		
3.4	Rated voltage	kV_{rms}	
3.5	Rated current	A_{rms}	
3.6	Rated capacitive breaking current	kA_{rms}	
3.7	Characteristic curve		
4	**Mounting Insulators**		
4.1	Manufacturer's name and country		
4.2	Rated one minute power frequency withstand voltage (Dry/Wet)	kV_{rms}	
4.3	Rated lightning impulse withstand voltage	kV_{peak}	
4.4	Max. vertical working loads	kN	
4.5	Max. cantilever working loads	kN	
5	**Specification Of Reactor**		
5.1	Type designation		
5.2	Manufacturer name		
5.3	Applicable standards		
5.4	Max. operating voltage	kV_{rms}	
5.5	Continuous rated current	A_{rms}	
5.6	Rated frequency	Hz	
5.7	Rated inductance	μ H	
5.8	Total losses at 75^0C	W	
5.9	Type of cooling		

SCHEDULE CAP (II)
GUARANTEED TECHNICAL INFORMATION OF CAPACITOR BANKS (TO BE SUPPLIED BY TENDER)

ITEM	DESCRIPTION		TECHNICAL PARTICULARS
5.10	Temperature category	°C	
5.11	Inrush current	kA_{peak}	
5.12	Insulation level:		
5.12.1	Rated one minute power frequency	kV_{rms}	
5.12.2	Rated lightning impulse withstand voltage	kV_{peak}	
5.13	Material of winding & insulation		
5.14	Type of connection:		
5.14.1	To capacitor		
5.14.2	To capacitor bank breaker		
5.15	Conductor cross-section	mm^2	
5.16	Net weight	kg	
5.17	Dimensions	mm×mm×mm	
5.18	Methods of mounting of reactors		
6	**Current Transformer**		
6.1	Manufacturer's name		
6.2	Type designation		
6.3	Class		
6.4	Type of main insulation		
6.5	Insulation class		
6.6	Rated voltage	kV_{rms}	
6.7	Rated one minute power frequency withstand voltage for secondary	kV_{rms}	
6.8	Rated lightning impulse withstand voltage (at standard condition)	kV_{peak}	
6.9	Rated primary current	A_{rms}	
6.10	Rated secondary current	A_{rms}	
6.11	Rated ratio		
6.12	Rated short time current for 1 second	kA_{rms}	
6.13	Rated dynamic current	kA_{peak}	
6.14	Continuous thermal rated current with respect to rated primary current	%	
6.15	Burden and accuracy class	VA	
6.16	Temperature rise	°C	
6.17	Material of primary terminal and conductor		
6.18	Material of secondary terminal and conductor		
6.19	Type of outer insulation		

SCHEDULE CAP (II)
GUARANTEED TECHNICAL INFORMATION OF CAPACITOR BANKS (TO BE SUPPLIED BY TENDER)

ITEM	DESCRIPTION		TECHNICAL PARTICULARS
6.20	Creepage distance	mm	
6.21	Max. permissible horizontal/ vertical force on primary terminal	N	
6.22	Dimensions	mm×mm×mm	
6.23	Weight	kg	
6.24	Specification of neutral current transformer		
7	**Voltage transformer**		
7.1	Manufacturer's name & country		
7.2	Type & designation		
7.3	Class		
7.4	Type of the main insulation		
7.5	Insulation class		
7.6	Rated primary voltage	kV_{rms}	
7.7	One minute rated power frequency withstand voltage	kV_{rms}	
7.8	Rated lightning impulse withstand voltage	kV_{peak}	
7.9	Rated secondary voltage	V_{rms}	
7.10	Number of secondary winding		
7.11	Short circuit impedance	Ω	
7.12	Accuracy class		
7.13	Thermal consumption power (for each winding/ total)	VA	
7.14	Rated output	VA	
7.15	Rated voltage coefficient		
7.15.1	For continuous duration		
7.15.2	For 8 hour duration		
7.16	Permissible secondary short circuit time with rated voltage in primary terminal	sec	
7.17	Temperature rise with respect to ambient temperature at rated power	°C	
7.18	Max. partial discharge value in recommended test in IEC standard	PC	
7.19	Method of connection to the capacitor bank		
7.20	Material of primary terminal and conductor		
7.21	Type of outer insulation		
7.22	Creepage distance	mm	
7.23	Max. permissible horizontal / vertical force on primary terminal	N	
7.24	Dimensions	mm×mm×mm	
7.25	Weight	kg	
7.26	Specification of neutral voltage transformer		