Technical Specification for 11 kV Packaged Substation

(With 250 / 400 / 630/ 1000 kVA Distribution Transformer - Hermetically Sealed Oil Type / Dry Type Transformer)

Specification no – SP-PSSC-38-R8

Prepared by		Reviewed by		Approved by		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
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Record of Revision

Revision No	Item / clause no.	Nature of Change/Clause Descriptions	Approved By
R3	4.2.13, 14.24	Added- 02 no's Smoke detectors for each compartment	DS
R3	4.2.15	Fire extinguisher position is added.	DS
R3	5.2.5	Anti-theft hinges are changed to Internal anti-theft hinges with opening angle of 120 deg. minimum.	DS
R3	5.2.6	Added – Operating Handle support	DS
R3	5.2.15.2	Bus bar short time withstand capacity changed to 20kA for 3 sec	DS
R3	5.2.18	Routing of control / auxiliary wiring is added	DS
R3	5.2.24.1	Added – Avoid any type of Gaps or holes on the cable termination chamber wall.	DS
R3	5.2.24.2,3	Added – internal arc rating	DS
R3	5.3.3	Separate ON/OFF switching for each motor is added	DS
R3	5.3.9	LBS short time withstand capacity revised to 20kA for 3 sec	DS
R3	5.3.10	LBS fault making capacity revised to 50kA peak	DS
R3	5.3.11	Mechanism endurance class M1 and Electrical Endurance class E3 specified	DS
R3	5.3.12	Minimum no. of operations at rated fault current specified – Electrical endurance class E3	DS
R3	5.4.2	CB arc interruption medium only in Vacuum bottle	DS
R3	5.4.4	Added – Protective flap on Emergency PB	DS
R3	5.4.6	20kA short time withstand capacity specified	DS
R3	5.4.7	Mechanical – M1 & Electrical-E2 endurance class specified for circuit breaker module	DS
R3	5.4.8	CB fault making capacity revised to 50kAspecified	DS
R3	5.4.9	CB fault breaking capacity revised to 20kA	DS
R3	5.4.10	Electrical Endurance – Class E2 specified for CB at fault current	DS
R3	5.4.12	Protection CT type specified- cast resin ring type	DS
R3	5.5.7	No load mechanical endurance class M0 specified for earth switch	DS
R3	5.5.8	Making capacity endurance class E2 specified	DS
R3	5.7.5.1	Added – Prevent electrical operation if handle is inserted for manual operation	DS
R3	5.7.5.2	Added – Supply to the motor shall be disconnected after certain time period if LBS fails to operate.	DS

R3	5.9.0	Sticker type mimic diagram non acceptance specified	DS
R3	5.9.2.5, 7.3.1.5, 7.19.1.5, 14.2	Added – Ref. IS / IEC No. on name plate	DS
R3	6.8, 7.3.8.1, 8.3.4.7	HV side bushings of transformer- Epoxy cast, 630 A, Interface type 'C'	
R3	7.2.2.6.5	Delta connection leads for Oil type transformer are defined to be with flexible cable connection	DS
R3	7.3.10.4, 5 and 8.3.5.3 and 4	Accuracy class and VA rating of the LTCT changed to 0.5s and 5 VA respectively.	DS
R3	8.5	Control / Auxiliary cables are changed to FRLS.	DS
R3	13.23	Specified – Internal arc classification	DS
R3	15.1.1, 15.2	Name plate materials are defined to be of SS material including BSES insignia and danger plate.	DS
R3	4.6, 9.2.0	Number of outgoing feeders specified Type I- 07 No's Type II- 05 No's Type III- 03 No's	DS
R3	4.2.2, 5.1.1	Requirement of 4 way RMU has been added for PSS type – I	DS
R4	2	IS 1180(2014) added	KKA
R4	7.2.1	Rating 990KVA changed to 1000KVA as per IS 1180 (2014)	KKA
R4	7.2.4	Impedance of 400KVA & 630KVA changed 4.5 %	KKA
R4	7.2.5.1 & 7.2.5.2	Total losses at 50% & 100% load updated as per IS 1180(2014)	KKA
R4	7.2.8	Flux density at 10% over excitation changed to 12.5% over excitation	KKA
R4	7.2.10	Tapping range changed to +5% to -10%	KKA
R4	7.3.5.2	Core material M4 to M3	KKA
R4	7.3.11.1	Range /Step changed to +5% to -10% in step of 2.5%	KKA
R4	8.3.1.2 & 8.3.1.3	Core material grade changed to M4 to M3 & Max Lamination Thickness changed .27mm to .23mm	KKA
R4	8.3.2.1 & 8.3.2.2	Winding material changed Electolytic ALuminum and Max Current density 1.5A/Sqmm	KKA
R5	7.2.5.1 & 7.2.5.2	Total losses at 50% & 100% load changed to Energy Efficiency level 1 from Energy Efficiency level 3 as per IS 1180(2014)	KKA

R6	10.2.2 & 10.2.10-13	MCCB Specifications revised	AT/VP
R6	7.2.5	Max losses revised	AT/VP
R6	13	Inspection expenses added	AT/VP
R7	4.0	PSS Configuration-added PSS type –IV	AT/KS
R7	9.0	Low Voltage Bus bar system-Bus bar rating of PSS-IV added	AT/KS
R7	10.0	Low Voltage switchgear, ACB,MCCB & fuses added	AT/KS
R7	13	Enclosure for package substation modified	AT/KS
R7	16	Approved Makes list added	AT/KS
R7	Annexure C	GTP added	AT/KS
R7	Annexure F	BOM for 250 kVA PSS added	AT/KS
R7	5.1.0	RMU Configuration clarified	AT/KS
R7	5.2.0	RMU panel construction –GI sheet added, sheet thickness specified from 2 to 2.5 mm.	AT/KS
R7	5.3.0	Load break switch / Isolator (LBS)-elaborated	AT/KS
R7	5.4.0	Circuit Breaker-parameters specified	AT/KS
R7	5.5.0	Earth switch-three position concept added.	AT/KS
R7	5.7.0	RMU operation interlocks- mechanical interlock mentioned	AT/KS
R7	5.8.0	Indication and signals modified	AT/KS
R7	5.10.0	Quality assurance-added	AT/KS
R7	5.11.0	Inspection and testing –specified	AT/KS
R7	5.13.0	Special Technical requirement-added	AT/KS

R7	5.14.0	Make List of RMU's Accessories-fixed and added	AT/KS
R7	7.2.4	Impedance at 75 deg C for 250 KVA added	AT/KS
R7	7.2.5	Losses at 75 deg C updated and 250 KVA added	AT/KS
R7	7.2.8	Flux density at rated conditions	AT/KS
R7	7.3.5.3 8.3.1.6	Core Design Features-Type of core added	AT/KS
R7	7.3.6.5	Winding Design features-Type of windind added	AT/KS
R7	7.3.10.7 8.3.5.6	CT ratio for 250 KVA added	AT/KS
R7	7.3.11.4	Rated Current for tap Switch for 250 KVA added	AT/KS
R7	8.1.13 8.1.14 8.1.15	E2C2F1 Certification for dry Type DT added	AT/KS
R7	8.2.5	Temperature for losses revised and 250 KVA added	AT/KS
R7	8.2.7 8.3.1.5	Flux density-maximum value at overfluxing revised	AT/KS
R7	8.3.1.4	Design Flux Density at rated conditions at principal tap	AT/KS
R7	18.1	Type test and special test details for transformer added	AT/KS
R7	18.3.2.2	IR value revised	AT/KS
R7	13.14	Degree of ingress protection against solids & water for transformer compartment revised	AT/KS
R7	16.0	Approved makes revised	AT/KS
R7	Annexure B	Properties of transformer oil revised	AT/KS
R7	Annexure D	CRGO & Testing Points added	AT/KS
R8	Common for all	Dry DT voltage ratio shall be 11 kv/415 volts instead of 11 kv/433 volts	AT/KS
R8	16.5.0	Addition in DT component make list	AT/KS

1.0 Scope

i. Design, manufacture, testing at manufacturer works before dispatch, packing, and delivery of Packaged Substation (PSS) as per this specification and supply of commissioning spares.
ii. Supply of all installation/commissioning accessories for PSS.
iii. Submission of documentation of PSS.
iv. Supervision of testing & commissioning of PSS at site.

2.0 Codes & standards

Materials, equipment and methods used in the manufacture of 11kV Packaged Substation shall conform to the latest edition of following –

Standard	Title
Indian Electricity Rules	With latest amendments
Indian electricity act	IE act 2003
	CBIP manual on transformers
IEC 60076	Power transformers
IEC:60616	Terminal and Tapping Markings for Power Transformers
IEC:60726	Dry-Type Power Transformers
IEC: 60529	Degrees of Protection Provided by Enclosures (IP Code).
IEC:60905	Loading Guide for Dry-Type Power Transformers
IEC 60694	Specification for high voltage switchgear
IEC 60439-1	Low voltage switchgear & control gear assemblies
IEC 60529	Degree of enclosures provided by enclosures
IEC 60664-1	Insulation coordination for low voltage systems
IEC 62262	Degree of protection provided by enclosure against mechanical shocks
IEC 62271-202	High voltage switchgear & control gear - prefabricated substation
IEC 60044	Instrument transformers - Current & voltage transformers
IEC 60225	Electrical relays
IEC 60625	High voltage switches
IEC 60502	Power cables
IEC 60947-2	Low-voltage switchgear and control gear : Circuit-breakers
IS 1180	Outdoor Type Oil Immersed Distribution Transformers Up to and Including 2500 kVA, 33kVSpecification **[R4]**
IS 2026	Power transformers
IS 11171	Dry type transformers

IS 6600	Loading of power transformers
IS 13947	Low voltage switchgear & control gear
IS 2099	Bushings for voltages above 1000v
IS 3156	Voltage transformers
IS 2705	Current transformers
IS 1554	PVC cables
IS 7098	XLPE cables
IS 2629	Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
IS 4759	Hot-dip zinc coatings on structural steel and other allied products
IS 13585	Shunt capacitors
IS 13340	Shunt capacitors
IS 3043	Code of practice for Earthing
IS 335-2018	Insulating oils
IS 8130	Conductors for insulated cables
IS 5	Ready mixed paints
IS 9920 part 1,3 & 4	High voltage switches above rated voltage 1kv
IS 13118	General requirements of circuit breakers above rated voltage 1kv
IEC 60694	Specification for high voltage switchgear
IEC 60298	AC metal enclosed switchgear
IEC 60694	Specification for high voltage switchgear
IEC 60056	High voltage alternating current circuit breakers
IEC 60265 part 1	High voltage switches

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows -

i. Guaranteed Technical Particulars (GTP)

ii. Specification including applicable codes & standards

iii. Approved Vendor Drawings

iv. Other documents

3.0 Electrical Distribution System Data

3.1.1	HT supply System	3 phase AC, 3 wire
3.1.2	Voltage	11000 volt ±10%
3.1.3	Frequency	50 Hz ± 5%
3.1.4	Fault level	350MVA – 18.5kA
3.1.5	System neutral	Earthed at upstream 11kV source

3.2.1	LT supply system	3 phase AC, 4 wire
3.2.2	Rated voltage	415V +/-10%
3.2.3	Rated frequency	50 Hz ± 5%
3.2.4	Fault level	35MVA – 50kA

4.0 PSS Configuration

4.1	PSS Type	On the basis of transformer rating
4.1.1	PSS Type – I	With 1000kVA oil filled transformer / 1000KVA cast resin transformer
4.1.2	PSS Type – II	With 630kVA oil filled transformer / 630KVA cast resin transformer
4.1.3	PSS Type – III	With 400kVA oil filled transformer / 400KVA cast resin transformer
4.1.4	PSS Type – IV	With 250kVA oil filled transformer / 250KVA cast resin transformer **[R7]**
4.1.4	Transformer type	As per enquiry
4.2	Major Components	For all PSS Types
4.2.1	Enclosure	Metallic painted GI enclosure with steel base frame for overall package
4.2.2	11kV Ring main unit	
4.2.2.1	PSS Type – I	1. The 3 Way with 02 nos. load break switches (LBS) + 01 no. circuit breaker (CB). Or 2. The 4 Way with 02 nos. Load break switches (LBS) + 02 nos. Circuit breaker (CB).**[R3]**
4.2.2.2	PSS Type – II , III & IV	The 3 Way with 02 nos. load break switches (LBS) + 01 no. circuit breaker (CB).
4.2.3	11kV XLPE Aluminium cable with termination kit along with cold applied boots	For CB feeder termination & transformer side termination.
4.2.4	Low voltage bus bar system	Insulated /sleeved with epoxy insulators

4.2.5	Low voltage system configuration for PSS type-I	1600A ACB incomer and 07 nos. 400A MCCB (utilization category- B) as outgoing.
4.2.6	Low voltage system configuration for PSS type-II	1600A ACB incomer and 05 nos. 400A MCCB (utilization category- B) as outgoing. Provisions shall also be made in LT panel to increase LT outgoing by 02 no's by adding MCCB's in future.
4.2.7	Low voltage system configuration for PSS type-III	1250A ACB incomer and 03 nos. 400A MCCB (utilization category- B) as outgoing. Provisions shall also be made in LT panel to increase LT outgoing by 02 no's by adding MCCB's in future.
4.2.8	Low voltage system configuration for PSS type-IV	400A ACB incomer and 02 nos. 250A MCCB (utilization category- B) as outgoing. **[R7]**
4.2.9	APFC system for PSS type-I	300kVAR APFC system with control relay & 630amp incomer MCCB (utilization category- B)
4.2.10	APFC system for PSS type-II	200kVAR APFC system with control relay & 630amp incomer MCCB (utilization category- B)
4.2.11	APFC system for PSS type-III	200kVAR APFC system with control relay & 630amp incomer MCCB (utilization category- B)
4.2.12	APFC system for PSS type-IV	Not Required **[R7]**
4.2.13	Energy meter box	To be provided on transformer LT side along with wiring.
4.2.14	Space for customer FRTU	300D x 600W x 900H (mm) space to be provided in HV or LV compartment.
4.2.15	Smoke detectors	Minimum 02 nos. in each LT, HT and Transformer compartment. These detectors shall be connected to local controller / alarm module. **[R3].**
4.2.16	Hooter with automatic timer reset	For operator alarm in case of PSS door open position
4.2.17	Fire Extinguisher	2Kg CO^2 Type shall be placed in HT Compartment **[R3]**.
4.2.18	Other requirements	Substation internal cabling, lighting & earthing system along with required hardware, gaskets, gland plates etc.
4.2.19	Fire ball	3 nos. of fire ball require in each compartment of all types of PSS **[R7]**
4.2.20	Cable Sealing compound	Cable sealing compound (Roxtec or any other make) require in LT & HT compartment as per cable size **[R7]**

5.0 11 kV Ring Main Unit

5.1.0	**RMU Configuration**	
5.1.1	RMU Configuration	
5.1.1.1	PSS Type – I	1. Two Load break switches (LBS) + one transformer circuit breaker (TCB) or 2. Two Load break switches (LBS) + two transformer circuit breaker (TCB). **[R3]** Selection between the above configurations shall depend upon the purchaser's requirement.
5.1.1.2	PSS Type – II, III & IV {R7}	The 3 Way with 02 nos. load break switches (LBS) + 01 no. circuit breaker (CB).
5.1.2	Extensibility	Non extensible type
5.1.3	Load break switch, Circuit breaker & earth switch in RMU panel	All shall be non draw out type, fixed position
5.1.4	Insulation Medium	
5.1.4.1	For panel	SF6 gas or Dry air in sealed metallic tank
5.1.4.2	For Breakers	SF6 gas or Vacuum type (with disconnector & earth switch)
5.1.4.3	For load break switches	SF6 gas or Vacuum type (With Earth Switch)
5.1.5	Arc interruption chamber for breaker	Arc interruption chamber of breakers shall be separate from the main insulated tank. (Desirable feature)
5.1.6	Maximum dimensions of 3 Way (2LBS+1VCB) RMU and for 4 Way(2LBS+2VCB)**[R7]**	3 Way-1250 mm(W) X 800 mm (D) X 2000 mm (H) 4 Way- dimension of 3 way+ one VCB compartment shall be added
5.2.0	**RMU Panel Construction**	
5.2.1	Panel type	CRCA/ GI Metal enclosed, framed, Compartmentalized panel construction **[R7]**
5.2.2	Service Location	Indoor and outdoor, non air conditioned environment **[R7]**
5.2.3	Mounting	Free Standing
5.2.4	Overall Enclosure Protection	IP54X minimum, vermin proof **[R7]**
5.2.5	Doors	Front access with internal anti theft hinge arrangement with minimum opening angle of 120º **[R3]**, minimum three hinges (desirable)
5.2.6	Covers	Bolted for rear access, with handles. Support for handle shall be provided at suitable place on RMU body. All the accessible bolts / screws shall be vandal proof stainless steel (except termination bolt, washer

		and reducer which is brass). One set of required Special tools per RMU (if any) shall be in the scope of supply. **[R7]**
5.2.7	Construction	CRCA/GI Metal enclosed, framed, Compartmentalized panel construction. CRCA/GI thickness shall be 2 to 2.5 mm subject to type test report from CPRI/ERDA**. Sheet thickness below 2 mm in any part of RMU shall not be accepted [R7]**
5.2.8	Base frame	Base frame shall be made with 75mm ISMC/ISA channel. Proper Bolted fixing arrangement shall be provided. Also, base frame shall be painted with 2 coats of anti rust red oxide and 2 coats of bitumen paint shall be provided. Adjustable HDPE clits as cable supporting clamps for each power cable (to suit the cable size from 11kV, 3CX150 to 400 sq mm PILC / XLPE cable. Exact size shall be provided during drawing approval stage.), also cleat shall be adjustable vertically. **[R7]**
5.2.9	Lifting lugs	Four numbers
5.2.10	Cable Entry	Bottom 3mm metallic, removable type & split type in two parts, with 1no. 90 mm diameter knocks out punch/hole in the centre (For double cable boxes, Un-drilled gland plate to be supplied. Approval should be taken for the same during drawing submission)
5.2.11	Cable termination	
5.2.11.1	Cable type & size	11kV, 3C X 150 / 240 / 300/ 400 sq mm Aluminium conductor XLPE/ PILC with armor & PVC outer sheath
5.2.11.2	Terminals for 11kV cable termination	With right angled cold applied boots (3M,Raychem or K.D. Joshi make), set of required size of Brass Nut bolt – M 16 size, Bimetallic washers and reducer for different size of cable termination to be provided. **[R7]**
5.2.11.3	Termination type	Suitable for heat shrinkable type
5.2.11.4	Termination height	900mm minimum from gland plate to center of bushing **[R7]**
5.2.12	Bus bar	Copper/Tinned copper (Sizing Calculation to be submitted in support of its Guaranteed S.C. rating / Capability) **[R7]**
5.2.12.1	Bus bar continuous rated current	630amp
5.2.12.2	Bus bar short time withstand capacity	20 KA for 3 sec **[R3]**
5.2.12.3	Bus bar support insulator material	SMC / DMC resin
5.2.12.4	Maximum temperature rise above reference ambient	In line with Table 3 of IEC60694

5.2.13	Earth bus bar	Tinned Copper sized for rated fault duty for 3 sec **[R7]**
5.2.13.1	Earth bus internal connection to all noncurrent carrying metal parts	By 2.5 sq mm copper flexible green PVC wire, Earth connection point maximum 1 meter away from cable test facility
5.2.13.2	Earth bus external connection to owners earth	Studs on both sides with holes and with M10 bolt + hardware to readily receive purchaser earth connection
5.2.14	Cooling arrangement	By natural air without fan
5.2.15	Panel internal wiring	Multi strand flexible color coded PVC insulated Cu wire 1 sq mm (SCADA) / 2.5 sq mm (for CT's) 1100 volt grade (R phase - Red, Y phase – Yellow, B phase – Blue, AC- black, DC – grey, Earth – green) with ferrules at both ends. All the internal control / auxiliary wiring shall be routed through proper conduit. **[R3]**
5.2.16	Hardware (Nut, bolts & handle)	Stainless steel (Except termination nut-bolts-washers-reducer which are Brass / Tinned Copper) **[R7]**
5.2.17	Gasket	Neoprene rubber
5.2.18	Marshalling terminal blocks	1 Sq mm, Nylon 66 material, screw type + 20% spare in each row of TB.
5.2.19	Panel cover fixing bolts	Allen head 6mm with hexagonal slot
5.2.20	Padlock facility	Required for all earth switches & all handles
5.2.21	Internal Arc classification	
5.2.21.1	Explosion vents	To ensure operator's safety, design should ensure that gases / flames generated during flash over / blast in any of the compartment, must not come out from the front of RMU as well shall not go to adjacent cable compartment. Internal arc test report (for Cable compartment & other compartments) must be submitted to support above, along with RMU GA drawing indicating these vents. There shall not be any type of holes, gaps etc on the walls of cable termination compartment. **[R3]**
5.2.21.2	Internal Arc rating	20 kA for 1s **[R3]**
5.2.21.3	Internal arc classification	IAC AFLR **[R3]**
5.2.22	SF6 gas annual Loss	< 0.1% of total mass. Pressure of SF6 gas shall be above the operating limit throughout the life of the equipment. **[R7]**
5.3.0	**Load break switch / Isolator (LBS) [R7]**	
5.3.1	Type	Three poles operated simultaneously by a common shaft

5.3.2	Arc interruption in dielectric medium	SF6 or Vacuum
5.3.3	Operating mechanism for close / open	Manual as per enquiry.
5.3.4	Addition / removal of motor	Without overhaul of operating mechanism **[R7]**
5.3.5	RMU without motor	Complete with power & control wiring so that only motor can be added at later date
5.3.6	Motor rated voltage	NA
5.3.7	Battery type & size	a) NA
5.3.8	Continuous rating of LBS	630 Amp at design 40 deg C ambient
5.3.9	Short time withstand capacity	20 KA for 3 sec **[R3]**
5.3.10	Fault making capacity	50 kA peak **[R3]**
5.3.11	Minimum number of operations at rated current (as per IEC 62271-102)	Mechanical Endurance – Class M1(1000 operations) Electrical Endurance – Class E3 (100 operations) **[R3]**
5.3.12	Minimum number of operations at rated fault current (as per IEC IEC 62271-102)	Class E3 (Min 10 operations) **[R3]**
5.3.13	Fault passage indicator (FPI) (For both Earth fault and Over Current Protection) {R7}	To be provided on incommer side of one LBS for panel type 1CB + 2 LBS. For all other configuration of RMU, FPI to be provided on all LBS.
5.3.14	Earth Fault Indicator	CBCT – Split open type suitable for mounting without disconnection of cable.
5.3.15	Connection of CBCT with FPI	Cable connection of FPI with CBCT shall be of pre moulded type on the CBCT side. Cable shall be 2.5 sq.mm cu PVC insulated cable only. {R7}
5.3.16	Fault Passage Indicator (For both Earth Fault and Over Current Protection)	Digital type and shall operate as the current exceeds the set value. Flash indication for identifying faults with red LED with one flash for every one sec. Test & rest button 1 NO + 1 NC potential free contact for remote indication FPI power supply unit shall use lithium battery with minimum life of 1000 blinking hours , so that FPI shall continue to function even after main feeder has tripped. **[R7]**
5.3.17	Data by Purchaser **[R7]**	
5.3.17.1	System Fault Level	2kA – 8.75kA
5.3.17.2	Type of Grounding	Solidly Grounded
5.3.17.3	Fault clearing time	100ms

5.3.17.4	Cable Type	PILC / XLPE , 11Kv, 3CX150 sq.mm to 400 sq.mm
5.3.18	Earth Fault Indicator	
5.3.18.1	Sensing Current	100 to 400A
5.3.18.2	Sensing Time	30 to 100 ms in steps of 10ms.
5.3.18.3	Reset Time	0.5 -1-2-3-4 hr
5.3.18.4	Resetting Facility	a) Self rest after reset time b) Self rest after restoration of voltage c) Manual d) Remote resetting
5.3.18.5	Contact Rating	1A at 230 V
5.3.18.6	Degree of Protection	IP 54
5.3.18.7	Mounting Arrangement	Surface or Flush Mounting
5.3.18.8	Ambient Temperature	-0 to 50 Deg C
5.4.0	**Circuit breaker [R7]**	
5.4.1	Type	Three pole, operated simultaneously by a common shaft
5.4.2	Transformer circuit breaker – TCB	For controlling transformer, manual operation only
5.4.3	Feeder circuit breaker - FCB	For controlling cable feeder, manual operation. Remote trip operation by SCADA possible
5.4.4	Arc interruption in dielectric medium	Vacuum Bottle
5.4.5	Operating mechanism - TCB	Manual spring charged stored energy type
5.4.6	Operating mechanism - FCB	Manual spring charged stored energy type, remote electrical close / open operation possible.
5.4.7	Emergency trip / open push button	On panel front with Protective flap to prevent any accidental tripping of breaker.
5.4.8	Continuous rating at design 40 deg C ambient	630amp
5.4.9	Short time withstand capacity	20 KA for 3 sec
5.4.10	Minimum number of operations at rated current (as per IEC 62271-100)	Mechanical Endurance – Class M1(2000 operations) Electrical Endurance – Class E2
5.4.11	Fault making capacity	50 KA peak
5.4.12	Fault breaking capacity	a) 20 KA Minimum
5.4.13	Maximum number of operations at rated Fault current *(as per IEC 62271-*	Electrical Endurance – Class E2 . To be guaranteed by manufacturer with authorized lab test reports

	100)	
5.4.14	Breaker status auxiliary contact	2NO + 2NC wired to terminal block
5.4.15	Current transformer	b) 75-400 / 1 amp for TCB/ FCB. c) Considering three core cable terminations, mounting flexibility shall be provided for CT's (in horizontal & vertical direction both). Additionally, CAUTION marking (by sticker/ paint) shall be provided to avoid CT's installation above the screen of cable. (I.e. earth potential point.) d) Position of CTs inside compartment shall be adjustable in vertical and horizontal direction
5.4.16	CT accuracy class	5P10 minimum
5.4.17	Protection relay	Self powered, Microprocessor based Numerical relay (with LCD display), IDMT over current / earth fault protection with high set element, manual reset type Relay mounting flush to panel front. Relay shall be communicable for automation purposes
5.4.18	Relay auxiliary contacts for remote indication	Potential free contact 1NO + 1NC wired to terminal block
5.4.19	Shunt trip 230v AC (for WTI trip & door limit switch of Dry type transformer) & for remote trip from SCADA.	To be wired to terminal blocks (If the functional requirement is achieved by the Protection relay, then shunt trip is not required.
5.4.20	Breaking Timing	40 to 60 ms
5.5.0	**Earth switch [R7]**	
5.5.1	Type	Three Pole (ON, OFF and Earth), operated simultaneously by a common shaft, for each Circuit breaker & Load break switch.
5.5.2	Switching in dielectric medium	Dry Air in sealed medium or SF6 gas
5.5.3	Operating mechanism for close & open	Manual
5.5.4	Fault making capacity	50 kA (Desirable)
5.5.5	Auxiliary contacts	1NO+1NC wired to terminal block
5.5.6	Disconnect switch (if provided in series with vacuum bottle)	Desirable to be located on purchaser cable connection side of vacuum bottle
5.5.7	Minimum number of operations at no load (as per IEC 62271-102)	Mechanical Endurance – Class M0(1000 operations)

5.5.8	Making capacity endurance of earth switch (as per IEC 62271-102)	Class E2 (Min 5 operations)
5.6.0	**Requirements of sealed housing live parts**	
5.6.1	Enclosure	Stainless steel enclosure suitable for IP67. Metal thickness shall be 3mm.
5.6.2	SF6 gas pressure low alarm	To be given
5.6.3	Provision for SF6 gas filling	To be given (For 'sealed for life' design of RMU, this is not applicable)
5.6.4	Provision for SF6 gas pressure indication	Digital/Analog Manometer with non return valve
5.6.5	Arc interruption method for SF6 breaker / Load break switch	Puffer type / rotating arc type
5.6.7	Potential free contacts for SF6 gas pressure low	1NO +1NC (Desirable)
5.7.0	**RMU operation interlocks [R7]**	
5.7.1	Interlock type	Mechanical
5.7.2	Load break switch & respective earth switch	Only one in 'close' condition at a time
5.7.3	Circuit breaker & respective earth switch	Only one in 'close' condition at a time
5.7.4	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'	Electrical / Mechanical
5.7.5	Prevent the closure of load break switch or circuit breaker if respective cable cover is open	Electrical / Mechanical
5.7.6	Cable test plug for LBS/CB accessible only if Earth switch connected to earth	Mechanical
5.8.0	**Indication & signals [R7]**	for SCADA / Local
5.8.1	Operation counter on front / Inside the RMU LT chamber	To be provided for each LBS & Circuit breaker, with minimum four digits & non resettable type
5.8.2	Cable charge status indication for all LBS & CB	Capacitor type voltage indicators with LED on all the phases (Shall be clearly visible in day light)
5.8.3	Spring charge status indication	On front for breaker
5.8.4	Earth switch closed indication (For Each LBS)	On front

5.8.5	Load break switch ON/OFF indication	Green for OFF / Red for ON
5.8.6	Circuit breaker On/OFF indication	Green for OFF / Red for ON
5.8.7	Circuit breaker protection relay operated on fault	Flag
5.8.8	Fault passage indication on LBS	Flag
5.8.9	Status signals to SCADA-to be wired to marshalling terminal block	2NO + 2NC
5.8.9.1	LBS close / open	potential free contacts
5.8.9.2	LBS & CB Earth Switch close /open	potential free contacts
5.8.9.3	CB close / open	potential free contacts
5.8.9.4	Protection relay operated	potential free contacts
5.8.9.5	FPI operated	potential free contacts
5.8.9.6	SF6 gas pressure low	potential free contacts - to be provided.
5.9.0	**Mimic diagram, labels & finish**	a) Mimic diagram (Shall not be accepted with Stickers) **[R3]** b) On panel front with description of function & direction of operation of handles/buttons
5.9.1	Operating Instructions	Operating instruction chart and Do's & Don'ts in Hindi / local language to be displayed on left / front side of panel enclosure on anodized Al Sheet 16SWG, duly affixed on panel.
5.9.2	Name plate on panel front	Fixing by rivet only
5.9.2.1	Material	Anodized aluminum 16SWG / SS
5.9.2.2	Background	SATIN SILVER
5.9.2.3	Letters, diagram & border	Black
5.9.2.4	Process	Etching
5.9.2.5	Name plate details	Month & year of manufacture, equipment type, input & output rating, purchaser name & order number, guarantee period
5.9.3	Labels for meters & indications	Anodized aluminum with white character on black background OR 3 ply lamicoid
5.9.4	Danger plate on front & rear side	Anodized aluminum 16 SWG with white letters on red background
5.9.5	Painting surface preparation	Shot blasting or chemical 7 tank process

5.9.6	Painting external finish	Powder coated epoxy polyester base grade A, shade - RAL 7032, uniform thickness 60 micron minimum
5.9.7	Painting internal finish	Powder coated epoxy polyester base grade A, shade - white, uniform thickness 60 micron minimum Printed copy shall be fixed/mounted inside each and every compartment.
5.10.0	**Quality Assurance [R7]**	
5.10.1	Vendor quality plan	To be submitted for purchaser approval
5.10.2	Inspection points in quality plan	To be mutually identified & agreed
5.10.3	Quality – Process Audits	BSES shall carryout vendor process audits.
5.10.4	Field quality plan	Bidder to submit field quality plan along with the bid
5.10.5	Spare part list	Bidder to submit detailed spare part list along with the bid
5.10.6	Maintenance manual	Bidder to submit maintenance manual along with the bid
5.10.7	Self Powered O/C & E/F Relay	Ashida ADR241S-761
5.10.8	Boots	3M / Raychem/K.D.Joshi
5.11.0	**Inspection and Testing [R7]**	
	Type test	1. Equipment of type tested quality only, including internal arc test (AFLR) shall be accepted as specified in the specification on various compartments like cable chamber, SF6 gas tank etc.(refer IS/IEC mentioned in the clause no 2.) 2. All Type test certificate along with AFLR internal test report from CPRI/ERDA/Any other reputed independent international Lab equivalent or better than CPRI/ERDA to be submitted along with offer for scrutiny. Type test more than 5 years old will not be acceptable. In case type test is more than 5 years old, bidder shall conduct type test from CPRI/ERDA/Any other reputed independent international Lab equivalent or better than CPRI/ERDA as per standard without any cost implication to BRPL. In this regards if BRPL want to witness the test , all the expenses of BRPL inspector shall be borne by bidder.
	Routine test	As per relevant Indian standard (refer IS …)
	Acceptance test	To be performed in presence of purchaser at manufacturer works
		Physical inspection & BOM, wiring check

		Insulation resistance test (Before & after HV test)
		HV test for one minute,
		Operation & interlock check
		Measurement of resistance of main circuit
		Voltage Indication check
		Functional testing of Fault passage Indicator for Alarm
		Primary current injection test for each circuit breaker feeder with relay
		Breaker closing & opening time measurement
		PD Test and CRM phase wise
5.12.0	**Deviations**	
	a) Deviations from this specification shall be listed separately by bidder clause wise (format given below) along with optional offer and has to submit the list along with bid/quotation. BRPL will review the deviations and if BRPL is agreed with the deviation, seller has to take written confirmation from BRPL on deviation during tender evaluation. b) In the absence of any separate list of deviations from the bidders with bid as well as written confirmation from BRPL on deviations, it will be assumed by the Buyer that the Seller complies with the Specification fully. c) Any deviations mentioned in any other submitted bid documents (i.e.in filled GTP, Catalog, BRPL old approval, buyer's/seller's standards etc) by seller without separate deviation sheets will not consider as a deviation from this tech spec at any stage of contract.	
5.13.0	**Special Technical Requirement [R7]**	
5.13.1	Self Powered Relay Protection setting (min 10%)	
5.13.2	NA".	
5.13.3	All the communicable accessories shall have Latch contact	
5.13.4	NO/NC contact for manometer shall be provided	
5.13.5	Each RMU shall be supplied with 2 sets of Operating Handle	
5.13.6	1. Cable termination drawing, cable termination instruction, dia wise bolt tighten torque range chat shall be fixed by sticker inside the termination compartment of each and every RMU. 2. Operation instruction manual of RMU shall be given with each and every RMU by OEM.	
5.13.7	In case of Motorized RMU required along with PSS in the place of Manual RMU (If requirement given by BRPL),bidder may refer technical specification only for motorized RMU- GN101-03-SP-76-01 or latest version of the same.	

5.14.0	Make List of RMU's Accessories [R7]	
Sl. No.	**Descriptions**	**Make**
1	Relay (Self Power+ AUX DC/AC Supply+ Communicable)	Ashida 241S-761
2	CT	Narayan Power Tech (NPT)/Gilbert Maxwell, 400/75-1/1, 5P10, 2.5 VA, Pragati, Nortex
3	FPI (Both for Earth Fault and Over Current Protection)	EMG/C&S/Schneider/SIEMENS
4	CBCT (Both for Earth fault and Over current protection)	EMG/C&S/Schneider/SIEMENS
5	Boot	3M/Raychem/K.D.Joshi
6	Wire	Polycab/Havells/Finolex/KEI
7	AC & DC MCB	SIEMENS/Havells/C&S/ Schneider
8	Disconnecting type fuses	Connectwell/Wago/Phoenix/Elmex
9	TB (disconnecting type)	Connectwell/Wago/Phoenix/Elmex
10	Vacuum Interrupter	CG/ ABB/Schneider/SIEMENS/other type tested

6.0 11KV XLPE Cable & termination kit

The 11kV XLPE cable connection from RMU to distribution transformer shall be conforming to IS 7098 and shall have all the following features -

6.1	Cable type & size	XLPE insulated armoured / un armoured cable 3C x 150 sqmm to 400 sqmm Aluminium conductor
6.2	Cable voltage grade	11KV
6.3	XLPE insulation thickness	3.14 mm minimum
6.4	Aluminium conductor no of strands	As per Table 2 of IS 8130
6.5	Insulation screen	With semi conducting extrusion, copper tape & water swellable tape
6.6	Type of armour	GI flat as per table 4 of 7098 part 2
6.7	11KV end termination at RMU	By 11kv grade end termination kit, heat shrink type
6.8	11KV end termination at Distribution transformer	By screened separable connector kit suitable for 630 A 'C'-interface epoxy cast bushings. **[R3]**
6.9	Cable support from RMU to transformer HT side cable	GI cable tray 300mm wide

	box	

7.0 Oil Type Sealed Distribution Transformer

7.1.0	Major Design criteria	
7.1.1	Voltage variation on supply side	+ / - 10 %
7.1.2	Frequency variation on supply side	+/ - 5 %
7.1.3	Combined variation of voltage and frequency	- 20 % or + 10 %
7.1.4	Service Condition	Refer Annexure B
7.1.5	Insulation level	
	One minute power frequency withstand voltage	3KV for 415V system & 28KV for 11KV system
	Lightning impulse withstand voltage	75KV peak for 11KV system
7.1.6	Short Circuit withstand level	
	Three phase dead short circuit at secondary terminal with rated voltage maintained on the other side	For 3 sec
7.1.7	Overload capability	As per IS 6600
7.1.8	Noise level	Shall not exceed limits as per NEMA TR-1 with all accessories running measured as per IEC 551 / NEMA standard running measured as per IEC 551 / NEMA standard
7.1.9	Radio Influence Voltage	Maximum 250 microvolt
7.1.10	Harmonic currents	Transformer to be designed for suppression of 3rd, 5th, 7th harmonic voltages and high frequency disturbances.
7.1.11	Partial Discharges	Transformer to be free from partial discharge up to 120% of rated voltage as the voltage is reduced from 150% of rated voltage i.e. there shall be no significant rise above background level.
7.1.12	Parallel operation with existing transformer z= 5%	Shall be designed to operate in parallel
7.2.0	Major Parameters	
7.2.1	Rating	**[R4]** 1000KVA/ 630 KVA/ 400 KVA/250 KVA [R7]
7.2.2	Voltage Ratio	11kv / 415 volts

7.2.3	Vector Group	Dyn11			
7.2.4	Impedance at 75 deg C	4.5 % for 250 KVA [R7] 400KVA & 630KVA tolerance as per IS **[R4]** 5% for 1000KVA tolerance as per IS **[R4]**			
7.2.5	Losses at 75 deg C	With ONAN cooling			
7.2.5.1	Total Loss –Max in KW at 50% Load	1000KVA	630KVA	400KVA	250KVA[R7]
		2.79 **[R7]**	1.86 **[R7]**	1.225 **[R7]**	0.98 **[R7]**
7.2.5.2	Total Loss –Max in KW at 100% Load	1000KVA	630KVA	400KVA	KVA[R7]
		7.70 **[R7]**	5.30 **[R7]**	3.45 **[R7]**	2.93 **[R7]**
7.2.6	Temperature rise top oil – without enclosure	35 Deg C max over ambient 40 Deg C			
7.2.7	Temperature rise winding – without enclosure	40 Deg C max over ambient 40 Deg C			
7.2.8	Flux density	1.6 Tesla **[R7]** at 100% rated voltage 1.9 Tesla at 112.5% rated voltage **[R4]**			
7.2.9	Current density	3 amp / sqmm for HV & LV winding			
7.2.10	Tapping on HV winding	Off circuit + 5% to -10% in 2.5% step **[R4]**			
7.2.11	Design Clearances	Phase - phase	Phase – earth		
	11kv system	180mm	120mm		
	415v system	25mm	25mm		
7.3.0	Transformer construction				
7.3.1	Type	Double Copper wound, three phase, oil immersed, with ONAN cooling			
7.3.2	Tank	Type tested design			
7.3.2.1	Design	a) Completely sealed type with corrugated fins and without conservator b) Completely oil filled or N2 cushion at top filled with positive pressure. N2 shall be technical grade in accordance with IS:1747 c) With bolted / welded cover			
7.3.2.2	Plate / Corrugated fin / tank features	a) Adequate for meeting mechanical & electrical withstand requirements, as per applicable standard. b) The tank and its sealing (gaskets, o-rings, etc.) shall be of adequate strength to withstand positive and negative pressures built-up inside the tank while the transformer is in operation. The maximum pressure generated inside the tank should not exceed 40kPa, positive or negative. c) Corrugated fins shall be built up of CRCA sheets of minimum 1.2mm thick. d) The corrugated tank wall shall ensure sufficient cooling of the transformer and compensate for the			

		changes in the oil volume during operation. e) The transformer shall be capable of giving continuous rated output, without exceeding the specified temperature rise. f) Internal clearance of tank shall be such that, it shall facilitate easy lifting of core with coils from the tank and HV & LV bushings mounted on Top cover. g) All joints of tank and fittings shall be oil tight. The tank design shall be such that the core and windings can be lifted freely with cover. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. h) Tanks with corrugations & without conservator shall be tested for leakage at a pressure as per the applicable standard.
7.3.2.3	Material of Construction	Mild steel plate with low carbon
7.3.2.4	Plate Thickness	To meet the requirements of pressure and vacuum type tests as per CBIP manual
7.3.2.5	Welding features	a) All seams and joints shall be double welded b) All welding shall be stress relieved for sheet thickness greater than 35 mm c) All pipes, stiffeners, welded to the tank shall be welded externally d) All corrugated fins or expansion bellows provided shall be double welded.
7.3.2.6	Tank features	a) Bottom with stiffeners & adequate space for collection of sediments b) No external pocket in which water can lodge c) Tank bottom with welded skid base d) Strength to prevent permanent deformation during lifting, jacking, transportation with oil filled. e) Minimum disconnection of pipe work and accessories for cover lifting f) Tank to be designed for oil filling under vacuum g) Tank cover fitted with lifting lug
7.3.3	Inspection cover for bushing & Core / Wind	As per manufacturer standard
7.3.4	Fittings and accessories on main tank	As per clause 7.3.0
7.3.5	Core	
7.3.5.1	Material	High grade , non ageing, low loss, high permeability, grain oriented, cold rolled silicon steel lamination
7.3.5.2	Grade	Minimum M3 or better **[R4]**
7.3.5.3	Core Design Features	a) Magnetic circuit designed to avoid short circuit paths within core or to the earthed clamping structures. b) Magnetic circuit shall not produce flux components

		at right angles to the plane of lamination to avoid local heating. c) Least possible air gap and rigid clamping for minimum core loss and noise generation. d) Adequately braced to withstand bolted faults on secondary terminals without mechanical damage and damage/ displacement during transportation and positioning. e) Percentage harmonic potential with the maximum flux density under any condition limited to avoid capacitor overloading in the system. f) All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling, welding. g) Provision of lifting lugs for core coil assembly. h) Supporting framework designed not to obstruct complete drainage of oil from transformer i) Core shall be in the form of step and stack in three limb format **[R7].** Note: No wound core shall be acceptable
7.3.6.0	Winding	
7.3.6.1	Material	Electrolytic Copper
7.3.6.2	Maximum Current Density allowed	Maximum 3 amp / sqmm
7.3.6.3	Winding Insulating material	Class A, non catalytic, inert to transformer oil, free from compounds liable to ooze out, shrink or collapse.
7.3.6.4	Winding Insulation	Uniform
7.3.6.5	Design features	a) Type of winding **[R7]:** LV: Spiral/Helical HV: Crossover/Disc Note: No foil winding shall be acceptable b) Stacks of winding to receive adequate shrinkage treatment. c) Connections braced to withstand shock during transport, switching, short circuit, or other transients. d) Minimum out of balance force in the winding at all voltage ratios. e) Conductor width on edge exceeding six times its thickness. f) Transposed at sufficient intervals. g) Coil assembly shall be suitably supported between adjacent sections by insulating spacers + barriers. h) Winding leads rigidly supported, using guide tubes if practicable. i) Winding structure & insulation not to obstruct free flow of oil through ducts.

		j) Delta connection shall be done using Flexible cable. **[R3]**
7.3.7.0	Transformer Oil	As per Annexure – C, Class 1 new mineral insulating oil, shall be certified not to contain PCBs. Naphthalene base with anti oxidant inhibitor subject to Purchaser's specification in Annexure - C
7.3.8.0	Bushings and Terminations	
7.3.8.1	Type of HV side bushing	Epoxy cast bushing, 630 Amp, interface type 'C' as per EN50180 and EN50181. **[R3]**
7.3.8.2	Type of LV side bushing	Indoor, Epoxy resin cast, 1kv voltage class and creepage 31mm/KV
7.3.8.2.1	Essential provision for LV side line bushing	It shall be complete with copper palm suitable for tinned copper bus bar of size 100x12 mm
7.3.8.2.2	Essential provision for LV side neutral bushing	In case of neutral bushing the stem and bus bar palm shall be integral without bolted, threaded, brazed joints. Bus bar size shall be 100x12 mm
7.3.8.3	Arcing Horns	Not required
7.3.8.4	Support insulators inside HV cable box if provided	Epoxy resin cast, 12KV rated voltage
7.3.8.5	Termination on HV side bushing	Cable connection by screened separable connector kit. **[R3]**
7.3.8.6	Termination of LV side bushing	Bus bar connection
7.3.8.7	Minimum creepage distance of all bushings and support insulators.	31mm/kv
7.3.8.8	Protected creepage distance	At least 50 % of total creepage distance
7.3.8.9	Continuous Current rating	Minimum 20 % higher than the current corresponding to the minimum tap of the transformer
7.3.8.10	Rated thermal short time current	26.3kA for 3 sec
7.3.8.11	Atmospheric protection for clamp and fitting of iron and steel	Hot dip galvanizing as per IS 2633
7.3.8.12	Bushing terminal lugs in oil and air	Tinned copper
7.3.8.13	Sealing washers /Gasket ring	Nitrile rubber/ Expanded TEFLON (PTFE) as applicable
7.3.9.0	HV cable box	N.A
7.3.9.1	Material of Construction	N.A
7.3.9.2	Cable entry	As per design
7.3.9.3	Cable size for HV	3C X150sqmm A2XWY 11KV

7.3.9.4	Connection on LV phase	Bus bar 100x12mm copper
7.3.9.5	Bus bar size for LV Neutral	Same as phase bus
7.3.9.6	Detachable Gland Plate material for HV cable box	N.A
7.3.9.7	Gland plate thickness for HV	N.A
7.3.9.8	Cable gland for HV	N.A
7.3.9.9	Cable lug for HV	Suitable for cable 3CX150 mm^2 11KV
7.3.9.10	Essential parts for HV cable box	N.A
		a) Flange type removable front cover with handles min two no's b) Tinned Cu Bus bar c) Earthing boss for the HV cable box. d) Earthing link for the gasketed joints at two point for each joint e) Earthing provision for cable Armour/ Screen f) Drain plug g) Danger / caution plate
7.3.9.11	Terminal Clearances HV phase – phase & phase - earth	180mm / 120mm
7.3.9.12	Termination height required for cable termination	750mm
7.3.10.0	Current Transformers	
7.3.10.1	Requirement	All three phases and neutral on LV side
7.3.10.2	Mounting	LV side bushings on all three phases and neutral with the help of fibre glass mounting plate affixed to main tank by nut bolt arrangement
7.3.10.3	Maintenance requirements	Replacement should be possible by removing fixing nut of mounting plate without disturbing LT bushing
7.3.10.4	Accuracy Class & ISF	0.5s / 10
7.3.10.5	Burden	5 VA
7.3.10.6	Type	Resin Cast Ring type suitable for outdoor use
7.3.10.7	CT ratio	a) 250 KVA-400/5 Amps **[R7]** b) 400/630KVA -1000/5 Amps c) 1000KVA -1500/5 Amp
7.3.11	Off Circuit tap Switch	On HV winding
7.3.11.1	Range /Step	+ 5 % to -10% in steps of 2.5 % **[R4]**
7.3.11.2	Type	Rotary type, 3 pole gang operated,
7.3.11.3	Operating Voltage	11kV

7.3.11.4	Rated Current for tap Switch	a) 100amp for 1000KVA /630KVA b) 60 amps for 400KVA /250KVA**[R7]**
7.3.11.5	Operating Handle	External at suitable height to be operated from ground level.
7.3.11.6	Tap position indicator	With direction changing facility, locking arrangement, caution plate metallic fixed by rivet.
7.3.12	Pressure Relief Device	Required
7.4.0	Hardware	
7.4.1	External	Stainless Steel
7.4.2	Internal	Cadmium plated except special hardware for frame parts and core assembly as per manufacturer's design
7.5.0	Gasket	
7.5.1	For Transformer, surfaces interfacing with oil like inspection cover etc.	Nitrile rubber based / cork
7.5.2	For Cable boxes, Marshalling box, etc.	Neoprene rubber
7.6.0	Valves	
7.6.1	Material of construction	Brass / gun metal
7.6.2	Type	Both end flanged gate valve / butterfly valve depending on application
7.6.3	Size	As per manufacturer's standard
7.6.4	Essential provision	Position indicator, locking rod, padlocking facility, valve guard, cover plate.
7.7.0	Painting of transformer.	
7.7.1	Surface preparation	By shot blasting method
7.7.2	Finish on internal surfaces of the transformer	Bright Yellow heat resistant and oil resistant paint two coats. Paint shall neither react nor dissolve in hot transformer insulating oil.
7.7.3	Finish on outer surface of the transformer-frame parts	Battle ship Grey shade 632 Poly urethane paint two coats, minimum dry film thickness 80 microns
7.8.0	Fittings & accessories	
7.8.1	Rating and Diagram Plate	Required
7.8.1.1	Material	Anodized aluminium 16SWG
7.8.1.2	Background	SATIN SILVER
7.8.1.3	Letters, diagram & border	Black
7.8.1.4	Process	Etching
7.8.1.5	Rating and Diagram Plate details	

		a) Following details shall be provided on rating and diagram plate as a minimum. b) Type/kind of transformer with winding material. c) IS/ IEC **[R3]** standard to which it is manufactured. d) Manufacturer's name. e) Transformer serial number. f) Month and year of manufacture. g) Rated frequency in HZ. h) Rated voltages in KV. i) Number of phases. j) Rated power in KVA. k) Type of cooling (ONAN). l) Rated currents in Amp. m) Vector group connection symbol. n) 1.2/50µs wave impulse voltage withstands level in KV. o) Power frequency withstands voltage in KV. p) Impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap q) Load loss at rated current. r) No-load loss at rated voltage and frequency s) Continuous ambient temperature at which ratings apply in deg c t) Top oil and winding temperature rise at rated load in deg c; u) Winding connection diagram with taps and table of tapping voltage, current and power v) Transport weight of transformer w) Weight of core and windings x) Total weight y) Volume of oil z) Weight of oil aa) Name of the purchaser bb) PO no and date cc) Guarantee period
7.8.2	Terminal marking Plate for Bushing, anodized aluminium black lettering on satin silver background both inside cable boxes near termination and on cable box cover (all fixed by rivet)	Required
7.8.3	Company Monogram Plate fixed by rivet	Required
7.8.4	Lifting Lug to lift complete transformer with oil	Required
7.8.5	Lifting lug for top cover	Required

7.8.6	Lashing Lug	Required
7.8.7	Jacking Pad with Haulage hole to raise or lower complete transformer with oil	Required
7.8.8	Detachable Bidirectional flat roller Assembly	Required
7.8.9	Pockets for ordinary thermometer on tank cover with metallic identification plate fixed by rivet.	Required
7.8.10	Drain valve (gate valve) for the main tank with cork above ground by 150mm minimum with padlocking and valve guard with metallic identification plate fixed by rivet.	As per manufacturer design
7.8.11	Filter valve (gate valve) at top with padlocking and valve guard with metallic identification plate fixed by rivet.	As per manufacturer design
7.8.12	Air Release Plug on tank cover with metallic identification plate fixed by rivet.	As per manufacturer design
7.8.13	Oil level indicator with low level switch	As per manufacturer design
7.8.14	Earthing pad on tank for transformer earthing complete with non ferrous nut bolt, washers, spring washers etc. with metallic identification plate fixed by rivet	Required
7.8.15	Rain hood for vertical gasket joints	Desirable
7.8.16	Earthing bridge by copper strip jumpers on all gasket joints at at least two points for electrical continuity	Required
7.8.17	Skid base welded type with haulage hole	Required
7.8.18	Core , Frame to tank Earthing	Required

7.8.19	Danger plate made of Anodized aluminum with white letters on red background on Transformer, cable boxes (all fixed by rivet)	Required
7.8.20	Caution plate for Off Circuit tap changer fixed by rivet.	Required
7.8.21	Pressure Relief Device	Required
7.8.22	Gas-inlet valve of non-return type	Required (for transformers with nitrogen blanket above oil)
7.8.23	User manual for Hermetically Sealed Transformers must be provided for review as a part of the technical proposal. The manual must be provided with, but not limited to, maintenance schedule, frequency & method of oil-sampling, procedures for oil-filling & oil-filtration, etc.	Required

8.0 Dry Type Transformer (1000KVA/ 630KVA/ 400KVA/250 KVA)

8.1.0	Major Design criteria	
8.1.1	Voltage variation on supply side	+ / - 10 %
8.1.2	Frequency variation on supply side	+/ - 5 %
8.1.3	Transient condition	- 20 % or + 10 % combined variation of voltage and frequency
8.1.4	Service Condition	Refer Annexure B, the transformer enclosure in PSS is to be designed for outdoor location with service condition as specified, but its full rating shall be available if located indoor in poorly ventilated atmosphere
8.1.5	Insulation Level	
	One minute power frequency withstand voltage	28KV for 11KV system & 3KV for 415 V system
	Lightning impulse withstand voltage	75KV peak for 11KV system

8.1.6	Short Circuit withstand Capacity of the transformer				
8.1.6.1	Three phase dead short circuit at secondary terminal with rated voltage maintained on the other side	For 3 secs.			
8.1.6.2	Single phase short circuit at secondary terminal with rated voltage maintained on other side voltage maintained on other side	For 3 secs.			
8.1.7	Overload capability	As per IEC 60905			
8.1.8	Noise level	Shall not exceed limits as per NEMA TR-1 with all accessories running measured as per IEC 551 / NEMA standard			
8.1.9	Radio Influence Voltage	Maximum 250 Microvolt			
8.1.10	Harmonic currents	Transformer to be designed for suppression of 3rd, 5th, 7th harmonic voltages and high frequency disturbances.			
8.1.11	Partial Discharges	Transformer to be free from partial discharge upto 120 % of rated voltage as the voltage is reduced from 150 % of rated voltage i.e. there shall be no significant rise above background level			
8.1.12	Parallel operation	Shall be designed to operate in parallel with existing transformer. Details of existing transformers shall be forwarded to the bidder on request			
8.1.13	Fire Protection Class	Class F1 shall be required **[R7]**			
8.1.14	Climate Class	Class C2 shall be required**[R7]**			
8.1.15	Environment Class	Class E2 shall be required**[R7]** Transformer shall be E2C2F1 certified **[R7]**			
8.2.0	Major Parameters				
8.2.1	Rating	1000KVA/ 630KVA/ 400KVA/250 KVA[R7]			
8.2.2	Voltage Ratio	11kv / 415 volts			
8.2.3	Vector Group	Dyn11			
8.2.4	Impedance	5%, tolerance as per IS			
8.2.5	Losses at 130 [R7] deg C				
8.2.5.1	No load Loss –Max in KW	1000 KVA	630 KVA	400 KVA	250 KVA[R7]
		1.78	1.2	0.9	0.7
8.2.5.2	Load losses at principal tap- Max in KW	1000 KVA	630 KVA	400 KVA	250 KVA[R7]
		7.5	5.4	3.4	2.2
8.2.6	Temperature rise winding	Outside PSS without		Inside PSS max.	

		enclosure	
		80°C	90°C
8.2.7	Flux density	Maximum flux density at 10 % over excitation /overfluxing-1.73 Tesla [R7] maximum	
8.2.8	Tapping on HV winding	Off Circuit taps on HV winding , + / - 5 % in steps of 2.5 % , change of taps by link	
8.2.9	Design Clearances	Phase – phase	Phase - earth
	11KV system	180mm	120mm
	415V system	25mm	25mm
	415V system	25mm	25mm
8.3	Construction & Design		
8.3.1	Core		
8.3.1.1	Material	High grade , non ageing, low loss, high permeability, grain oriented, cold rolled silicon steel lamination	
8.3.1.2	Grade	Premium grade minimum M3 or better **[R4]**	
8.3.1.3	Lamination thickness	0.23mm (Max) **[R4]**	
8.3.1.4	Design Flux Density at rated conditions at principal tap	1.6 Tesla [R7]	
8.3.1.5	Maximum Flux Density at 10 % over excitation / over fluxing	1.73 Tesla [R7] maximum allowed	
8.3.1.6	Core Design Features	a. All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling, welding. b. Core shall be in the form of step and stack in three limb format [R7]. Note: No wound core shall be acceptable c. Provision of lifting lugs for core coil assembly	
8.3.2	Winding		
8.3.2.1	Material	Electrolytic Aluminum **[R4]**	
8.3.2.2	Maximum Current Density allowed	Maximum allowed 1.5 A per sqmm **[R4]**	
8.3.2.3	Winding Insulating material	Class F minimum, free from compounds liable to ooze out, shrink or collapse. Uniform insulation shall be applied to the windings and overall winding shall be epoxy cast resin	
8.3.2.4	Tapping	Off Circuit taps on HV winding , + / - 5 % in steps of 2.5 % , change of taps by link	
8.3.2.5	Essential provision for tap links	Shall be shrouded with cover made from insulating material. To prevent deposit of dust.	

8.3.2.6	Design features	a) Stacks of winding to receive adequate shrinkage treatment b) Connections braced to withstand shock during transport, switching, short circuit, or other transients. c) Minimum out of balance force in the transformer winding at all voltage ratios. d) Conductor width on edge exceeding six times its thickness e) The termination bus-bar coming out from winding shall be tinned Copper f) Transposed at sufficient intervals. g) Threaded connection with locking facility. h) Winding leads rigidly supported, using guide tubes if practicable i) Provision of taps as indicated in the technical particulars
8.3.2.7	Essential provision of HV and LV winding leads	Phase marking required near termination on both HV and LV side. Phase colour coding required on insulating sleeves on both HV and LV side. Phase sequence 1U, 1V, 1W from left to right looking inside from the HV side door. Phase sequence 2n, 2u, 2v, 2w from right to left looking inside from LV side door Adequate HV termination clearance. Provision of check nut in all HV and LV winding lead connection.
8.3.3	Vibration Isolator	Vibration isolation pads shall be installed between core and coil assembly and enclosure base assembly to prevent the transmission of structure borne vibrations.
8.3.4	Bushings/Support Insulator/ terminations	
8.3.4.1	Type of HV and LV Bushings, support insulators	Epoxy Resin Cast
8.3.4.2	Minimum Creepage of bushings and support Insulators	31 mm / kV
8.3.4.3	Arcing horns	Not required
8.3.4.4	Termination on HV side	By cable within main enclosure by separable connector
8.3.4.5	HV side cable size	11 kV (E) grade , A2XCEWY 3C x 150 sqmm
8.3.4.6	Cable lugs	Long barrel medium duty Aluminium lug with knurling on inside surface. and suitable for cable size for 11 kV (E) grade , A2XCEWY 3C x 150 sqmm
8.3.4.7	HV side bushing	Epoxy cast bushing, 630 Amp, interface type ‘C’ as per EN50180 and EN50181. **[R3]**
8.3.4.7	Termination on LV side	Suitable bus bar as per PSS spec
8.3.5	Current Transformers	

8.3.5.1	Mounting	On LV side terminal busbars on all three phases and neutral with the help of fibre glass mounting plate
8.3.5.2	Maintenance requirements	Replacement should be possible without dismantling LV side support insulators
8.3.5.3	Accuracy Class	0.5s
8.3.5.4	Burden	5VA
8.3.5.5	Type	Resin Cast Ring type suitable for outdoor use
8.3.5.6	CT ratio	a) 250 KVA-400/5 Amps[R7] b) 400/630KVA -1000/5 Amps c) 1000KVA -1500/5 amp
8.3.6	Hardware	
8.3.6.1	External	Stainless Steel only
8.3.6.2	Internal	Cadmium plated except special hardware for frame parts and core assembly as per manufacturer's design
8.4	Gasket	Neoprene rubber based gasket across all doors & covers
8.5	Control cable specification (to be used by the vendor)	PVC insulated, extruded PVC inner sheathed, FRLS **[R3]**, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sqmm for signals and 4 sqmm for CT with multistrand copper conductor
8.6	Terminal Blocks to be used by the vendor	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit.
8.6.1	Essential provision for CT terminals	Sliding link type disconnecting terminal block screwdriver operated stud type with facility for CT terminal shorting material of housing melamine/ Nylon66
8.7	Painting of WTI box	
8.7.1	Surface preparation	By 7 tank pre-treatment process or shot blasting method
8.7.2	Finish on internal / external surfaces	Polyurethane based painting, min. Dry film thickness 80 microns
8.7.3	Insulating support material for base plate for mounting components	Bakelite shall not be used as a base plate for mounting any components, insulating material non hygroscopic insulating material like FRP shall be used.
8.8	Minimum Protective devices on Transformer	
8.8.1	Surge Arrestor	Required, Connected on Transformer Primary side on all three phases
8.8.1.1	Type	Metal oxide
8.8.1.2	Housing	Polymeric preferable
8.8.1.3	Rating	9 KV.
8.8.1.4	Continuous operating voltage , kV rms	6.35
8.8.1.5	Maximum Continuous operating voltage, kV rms	7.65

8.8.1.6	Nominal Discharge Current, kA peak	5
8.8.1.7	Energy Absorption Capability, kJ/kV	Greater than 2.5
8.8.1.8	Creepage factor	31 mm /kV
8.8.1.9	Reference std	IS 3070 part 3 and IEC 99-4
8.8.2	Winding Temperature scanner	Required
8.8.2.1	No of RTD inputs	Five (Three for windings, one for enclosure & one shall be spare) RTD for enclosure temperature monitoring shall be fixed at enclosure Top from inside to give max enclosure temp reading & shall be wired up to temp. scanner to indicate the reading
8.8.2.1.1	Location of winding RTD	At location of winding where maximum temperature is expected.
8.8.2.2	No of potential free trip contacts	Two
8.8.2.3	No of potential free Alarm contacts	Two
8.8.2.4	Auxiliary supply	240 V AC, 1 phase, 50 Hz. Tapped from LV side busbar through a MCB located inside box
8.8.2.5	Winding Temperature Scanner terminal Box	Required
8.8.2.5.1	Size	As per Manufacturer's Standard
8.8.2.5.2	Fixing of instrument within box	On base plate
8.8.2.5.3	Fixing of terminals within the box	On C channel available with the terminals
8.9	Fitting and accessories	
8.9.1	Rating & Diagram plate	Required
8.9.1.1	Material	Anodized aluminum 16SWG
8.9.1.2	Background	SATIN SILVER
8.9.1.3	Letters, diagram & border	Black
8.9.1.4	Process	Etching
8.9.1.5	Name plate details	Following details shall be provided on rating and diagram plate as a minimum a) Type of transformer i.e cast resin or VPI etc. With winding material b) IS / IEC **[R3]** standard to which it is manufactured c) Manufacturer's name; d) Transformer serial number; e) Month and year of manufacture f) Rated frequency in HZ g) Rated voltages in KV h) Number of phases

		i) Rated power in KVA j) Type of cooling k) Rated currents in a l) Vector group symbol m) 1.2/50µs wave impulse voltage withstand level in KV n) Power frequency withstand voltage in KV o) Impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap at highest temperature p) Load loss at rated current at highest temperature q) No-load loss at rated voltage and frequency r) Auxiliary loss s) Continuous ambient temperature at which ratings apply in c t) Winding connection diagram with taps and table of tapping voltage, current and power u) Transport weight of transformer v) Weight of core and windings w) Weight of enclosure and fittings x) Total weight y) Tapping details z) Phase ct details aa) Class of insulation bb) IP protection rating of the enclosure cc) Name of the purchaser dd) Po no and date ee) Guarantee period
8.9.2	Detachable Bi-directional flat Roller Assembly	Required
8.9.2.1	Roller center to center distance	Minimum 900 mm on the side of HV and LV termination Maximum 800 mm on the other side (perpendicular to HV, LV termination). and LV termination Maximum 800 mm on the other side (perpendicular to HV, LV termination).
8.9.2.2	Essential provision	Roller dia. 150 mm min., roller to be fixed in such a way so that the lowermost part of the skid is above ground by at least 100 mm when the transformer is installed on roller.
8.9.3	Earthing pad on enclosure for transformer earthing complete with Stainless Steel nut, bolt, washers, spring washers etc.	Required with identification plate on outside of enclosure.
8.9.4	Core, Frame to tank Earthing	Required
8.9.5	Off Circuit tapping link	Required
8.9.6	Tap link position plate	Required inside HV side door

8.9.7	Danger plate made of Anodized aluminium with white letters on red background on HV and LV side	Required
8.9.8	Skid with Haulage lugs	Required
8.9.9	Lifting lugs for complete transformer as well as enclosure	Required
8.9.9.1	Essential provision for lifting lugs	Lifting lugs for core coil assembly shall be provided in such a way that the weight shall not come on canopy while lifting Lifting lugs for canopy/ enclosure shall be provided in such a way that the weight shall not come on canopy while lifting , it shall be borne by supporting members.
8.9.10	Caution Plate for tap links	Required
8.9.11	Ventilation louvers with stainless steel wire mesh and rain water guard	Required as per Manufacturer's design, but it is to be provided minimum required preventing ingress of excessive dust.
8.9.12	Surge Arrestor & its Grounding bushing	Required
8.9.12.1	Essential provision	Surge arrestor shall be erected vertically in such a way that the surge arrestor can be removed at site without removing HV cable lug. Surge arrestor shall not be used for any kind of support. Surge arrestor grounding strip to be routed to the surge arrester grounding bushing near bottom of enclosure with proper support. Surge arrestor grounding bushing shall be identified by identification plate on outside of enclosure. Surge arrestor grounding bushing shall be supplied with all hardware to readily connect purchaser's ground lead.
8.9.13	LV additional neutral earthing bushing	Required
8.9.13.1	Essential provision	Busbar connecting the neutral to additional neutral bushing shall be properly supported and additional neutral bushing shall be identified by identification plate on outside of enclosure. Additional neutral bushing shall be supplied with all hardware to readily connect purchaser's ground lead.
8.9.14	Winding temperature scanner	Required
8.9.15	RTD in Winding and near top of enclosure.	Required
8.9.16	Space heater inside enclosure	Thermostatically controlled space heater inside enclosure required, supply of space heater from feeder pillar through MCB fixed properly inside enclosure.
8.9.1	Mounting of space heater	By suitable spacers so that heater does not come in contact with panel wall directly.

8.9.17	Copper earthing link	Across all gasketted joints in the enclosure body.

9.0 Low Voltage Bus bar system

9.1	LV bus bar	From transformer LV bushing to ACB and from ACB to MCCBs
9.2	Type of connection on transformer	By flexible copper link rated 1600Amp
9.3	Bus bar size for phase & neutral	a) 100x12 mm tinned copper / Eqvt Size Aluminum. b) Connection to each MCCB by 40x6 tinned copper bar.
9.4	Bus bar support insulators	1 KV voltage class, SMC epoxy
9.5	Insulator creepage distance	31mm / KV
9.6	Bus bar sleeve insulation	Color coded, for 1kv
9.7	Bus bar rated current	Type I & II:1600 Amp Type III:1250 Amp Type IV : 500 Amp **[R7]**
9.8	Bus bar short circuit withstand	27.7kA for 1 sec
9.9	Maximum temperature rise	20º C

10.0 Low voltage switchgear, ACB, MCCB & Fuses

10.1.0	Air Circuit Breaker (ACB)	Fixed type 4 pole
10.1.1	ACB - On & OFF operation	Manual as well as electrical by spring charged mechanism
10.1.2	ACB operating mechanism	Trip free, anti pumping type
10.1.3	Spring charging method	Manual as well as electric motor
10.1.4	Spring charging motor supply	1 ph 240V tapped from LV bus bar
10.1.5	Close & trip coil supply	1 ph 240V tapped from LV bus bar
10.1.6	ACB Neutral connection	Fully isolable link sized for 1600 / 1250 / 400 [R7] amp
10.1.7	ACB rated voltage	415v +/- 10% at 50Hz
10.1.8	ACB rated current	1600 / 1250 / 400 amp continuous
10.1.9	ACB rated 3 phase short circuit breaking capacity Ics = Icu	50kA minimum at 415v and 50Hz

10.1.10	ACB rated 3 phase short circuit withstand capacity, Icw	50kA for 1sec
10.1.11	ACB SC making current capacity	100kA peak
10.1.12	ACB rated insulation level	1000volt
10.1.13	ACB mechanical & electrical endurance	As per IS 13947 / IEC
10.1.14	ACB utilization category as per IS	B
10.1.15	ACB indications	ON, OFF & TRIP
10.1.16	ACB operation - manual	ON, OFF by push buttons
10.1.17	ACB operation - electrical	ON, OFF by TNC switch
10.1.18	ACB overload, short circuit & earth fault protection	By micro processor based releases
10.1.19	Operation counter	4 digit minimum , Non reversible **[R7]**
10.1.20	Multifunction meter	Digital CTR & PTR programmable **[R7]**
10.1.21	Display & Event log	Display type LT ACB required with Min. 10 nos previous fault event log **[R7]**
10.2.0	MCCB	For outgoing feeders – 400A 07 no for Type I PSS, 05+02* no's for type II PSS& 03+02* no's for Type III PSS 02 nos for type IV PSS **[R7]** APFC system – 1 no. 630 Amp *Spare Outgoings - Provisions shall also be made in LT panel to increase LT outgoing by 02 no's by adding MCCB's in future.
10.2.1	MCCB type	3 pole, one break per pole, Utilization category B
10.2.2	MCCB - On & OFF operation	Manual by handle
10.2.2(i)[R6]	MCCB design ambient temperature	50deg C
10.2.2(ii)[R6]	MCCB Housing	Thermoplastic material resistant to fire & abnormal heat , non hygroscopic
10.2.2(iii)[R6]	MCCB Terminal	Silver coated copper with phase barriers, spreader terminals & shrouds
10.2.2(iv)[R6]	MCCB Spreader size & material	Minimum-50(W)X50(L)X10(D)mm- Cu suitable for bimetallic joint i.e. for aluminium bus/cable lug
10.2.2(v)[R6]	De-rating at 50Deg ambient temperature	No derarting (0%)

10.2.3	MCCB rated 3 phase short circuit breaking capacity Ics = Icu	36kA minimum at 415v and 50Hz
10.2.4	MCCB rated 3 phase short circuit withstand capacity, Icw	8kA for 1sec
10.2.5	MCCB SC making current capacity	75kA peak
10.2.6	MCCB rated insulation level	1000V
10.2.7	MCCB mechanical & electrical endurance	As per IS 13947 / IEC
10.2.8	MCCB utilization category	B as per IS / IEC 947
10.2.9	MCCB indications	ON, OFF & TRIP
10.2.10	MCCB protection	Microprocessor based release + earth fault
10.2.10(i)[R6]	Tripping characteristic required	
a	Overload setting	Range 60-100%In (Set on 95%)
b	Short Circuit setting	Range 200-1200%In (Set on 300%)
c	Earth fault setting	To be provided
10.2.11[R6]	MCCB Clearances in air	As per table XIII of IS 13947-1
10.2.12[R6]	MCCB temperature rise limits	As per table 2 & 3 of IS 13947-1
10.2.13[R6]	MCCB Ingress Protection	IP2X Minimum (pollution degree minimum 2)
10.2.13(i) [R6]	MCCB additional features	Sealing/padlocking of operating knob in OFF position Sealing/padlocking of operating knob in OFF position isolation suitable with positive contact
10.2.14	Connection to ACB main bus	By Cu bar with double PVC insulation For 400 amp MCCB / fuse – 40x6 mm For 630 amp MCCB – 50x10 mm
10.2.15	Connection to outgoing cables	By terminals suitable for 2X4CX300sqmm , A2XFY 1100 volt grade cable [R7]

11.0 Automatic Power Factor Correction system

The APFC equipment shall be located in LV compartment of package enclosure either as a separate panel or integrated along with LV Switchgear and shall have all the following features –

11.1	APFC Output	a) Type I :300 KVAR @ 400 V b) Type II and III :200 KVAR @ 400 V

		However APFC should be rated at 440 V. Manufcatuerer needs to spcify rated output @ 440V.
11.2	APFC mounting	All components mounted in shelf type arrangement on package substation enclosure LV compartment wall or RMU compartment wall or Part of LT Panel
11.3	APFC relay & data logger	Mounted on base plate supported on compartment wall by three hinges
11.4	APFC system bus bar power connection to transformer LT side	By 4CX300sqmm AYFY 1100v grade cable to or Bus Bars
11.5	APFC system bus bar size	50x10mm tinned copper mounted on SMC insulators 1100V grade
11.6	APFC system CT input signal	From CT on transformer LV side by 7CX2.5sqmm YY 1100V grade cable
11.7	APFC capacitor modules	Type I:12x25KVAR three phase compensation Type II & III:8x25KVAR three phase compensation
11.8	Capacitor duty contactor for each capacitor module	Utilization category 6b as per IS
11.9	MCCB for each capacitor module	100amp, Three Pole, Ics=Icu=35kA
11.10	Connection to each MCCB from APFC system bus	By 35sqmm copper wire double insulated with tinned copper lugs
11.11	APFC control supply	Through 415/240v transformer, 2amp / 6amp SP MCB
11.12	APFC relay	Microprocessor based relay for automatic control of minimum 12 capacitors in sequential or cyclic switching fashion with settable time delay 0 -180 sec
11.13	APFC relay LCD display with self monitoring feature	To show no. of capacitors energized, actual PF & target PF, voltage & current
11.14	Target power factor setting range	0.8 lag to 0.9 lead in steps of 0.1
11.15	APFC relay sensing	3 phase CT input 5 amp to sense max load current
11.16	No volt protection in relay	To switch OFF all capacitors
11.17	Capacitor unit 25KVAR type	Double layer All Poly Propylene (APP) or Mixed Poly Propylene (MPP)
11.18	Capacitor unit construction	1.5mm thick sheet metal welded tank or Al cylindrical construction
11.19	Capacitor unit impregnant	Dry type filler or non PCB liquid
11.20	Capacitor unit conducting layer	Al foil or metalized film
11.21	Capacitor sealing	Hermetic sealing after vacuum process
11.22	Capacitor unit safety	Pressure sensitive dis-connector or internal fuse for each element
11.23	Discharge resistor	Between all three phases of capacitor unit, to reduce the voltage across the capacitor to 50V or less in one minute

11.24	Terminal bushings	For rated voltage class 1 KV Suitable wires / terminals brought out from capacitor unit is also acceptable.
11.25	Earth connection for individual capacitor container	To be done & connected to main earth bus bar of the panel
11.26	APFC Operational features	
11.26.1	Automatic power factor correction	To achieve target lagging power factor without hunting
11.26.2	Operation for rated output	At continuous rated voltage (440 V) & frequency (50 Hz)
11.26.3	Operation with over voltage	115% of rated voltage for 12 hours in a day
11.26.4	Operation with harmonic distortion	THD voltage – 5% & THD current 3%
11.26.5	Maximum permissible over current	1.3 times rated current, continuous
11.26.6	Dielectric loss	0.2 watt per KVAR maximum
11.26.7	Temperature Category & Maximum temperature rise	- 5 / 60 deg C Not exceeding 10 deg C over 60 deg C.
11.26.8	Residual voltage after disconnection from mains	50 volts maximum after 60 seconds
11.26.9	Design life of capacitor unit	Minimum 10 years
11.27.0	Data Logger	(approved by requisite authority / Electrical inspector)
11.27.1	General	Accuracy class 0.5, microprocessor based with LCD display, with 3 CTs for measurement of cumulative KWH, power factor, voltage & current of transformer secondary, THD of voltage.
11.27.2	Data logging and Software	Data logging of KWH value at every 30 minutes to give cumulative reading of KWH for 45 days minimum, data downloadable in ASCII-II or MS Excel format. Software for downloading the data from data logger to be provided by data logger vendor.
11.27.3	Display and communication	Display of DATE, TIME, station ID -Display & log power parameters phase wise & total (load current, kVA, kW & PF). -Display & log kVAr phase wise & total. -Display TDH V or current. -The logger shall be with built in communication facility of RS485 / RS232 to down load all parameters on demand.

12.0 Energy Meter Box

12.1	Energy meter	In the scope of purchaser
12.2	Location	To be provided mounted on enclosure wall in LV compartment.

12.3	Energy meter box Size	650 mm height x 450 mm width x 275 mm depth.
12.4	Box door design	With antitheft hinge, padlock facility, door fixed by stainless steel Allen screw M6 size.
12.5	Fixing of energy meter within box	On slotted horizontal channel 40 x 12 mm size, channel shall be movable on vertical slotted angle 40 x 40 mm size at two ends.
12.6	Meter reading window	Front door shall be with acrylic sheet for viewing the energy meter.
12.7	Sealing arrangement	02 no's sealing arrangement shall be provided on meter box's door.
12.8	Data downloading port	Slot shall be provided on door of meter box for fixing 9 pin DB connector (RS232 serial port).
12.9	Test Terminal Block	No Test terminal block shall be provided.
12.10	Cables and wires	PVC insulated, extruded PVC inner sheathed, armored, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sq mm for PT and 4 sq mm for CT with multi strand copper conductor.
12.11	Cable Glands	Nickel plated brass double compression weatherproof cable gland.
12.12	Wiring diagram	To be fixed on the back of door along with CT spec. etched on Anodised Aluminium plate fixed by rivet.
12.13	CT / PT Secondary wires	All CT and PT's Secondary wires shall be routed through metallic conduit. All secondary wires shall be bunched and kept for termination without any terminal/ TTB in between.

13.0 Enclosure for packaged substation

13.1	Service conditions	For outdoor use
13.2	Material for enclosure	Galvanised Sheet steel 2mm thick with outer finish painting
13.3	Enclosure construction	Frame supported construction with all doors, covers welded with steel channel ribs at every 1000mm minimum
13.4	Lifting lugs for site handling / lifting by crane	Four numbers on top to enable lifting of total package unit without any problem
13.5	Doors for RMU compartment & LV compartment	With internal anti theft hinge with minimum opening angle of 120º **[R3]**, minimum 3 nos., with lockable handle & with padlocking facility
13.6	Two side covers for transformer compartment	Bolted with Allen head type bolts to main frame
13.7	Top & other side walls of package substation enclosure	Welded sheet metal to main frame

13.8	Removable canopy above top cover	2mm thick sheet metal with 10º slope
13.9	Enclosure integral steel base frame	'I' section of suitable size to support total static and dynamic load
13.10	Base frame bottom support pads for fixing by bolt to foundation	Minimum six numbers to rest on foundation
13.11	Enclosure compartments	Separate compartments for RMU, transformer & LV switchgear/APFC
13.12	Separation between RMU & transformer compartment	By sheet steel 2mm thick
13.13	Separation between transformer compartment & LV compartment	By sheet steel 2mm thick
13.14	Degree of ingress protection against solids & water as per IS12063	IP53 for RMU compartment IP 34 for transformer compartment **[R7]** IP54 for LV compartment
13.15	Louvers on side covers of transformer compartment & side walls of LV compartment	To be provided with steel wire mesh welded from inside so as to meet IP requirement as above
13.16	Louver area on cover / side wall	1500mm height x 1500mm desirable
13.17	Louver position from bottom level	Minimum 200mm above bottom
13.18	Exhaust Fans	Mounted in LV compartment to discharge air in transformer compartment & Controlled by SPMCB & thermostat to operate above 35 deg C, 2x150CFM, 1 ph 230v 50Hz
13.19	Gland plate for RMU compartment	3 mm thick MS plate suitable for 3x3c300/400 sqmm AYFY 11kv cable
13.20	Gland plate for LV compartment	3 mm thick MS plate suitable for 10x 4c400sqmm cable + 10x7c2.5sqmm cable
13.21	Door Opening Provision	Type I, II & III : With 3 side door opening
13.22	Class of enclosure as per IEC 62271-202	10K
13.23	Internal Arc classification	IAC AB 20 KA, 1s **[R3]**
13.24	Limiting dimensions of package enclosure	
13.25 a	Type I (1000KVA Transformer):	3400(L) x 2900(W) x 2800(H)
13.25.b	Type II & III (400KVA /630KVA Transformer)	3400(L) x 2600(W) x 2600(H)
13.26	Type IV (250 kVA	2000(L) x 2000(W) x 2000(H) **[R7]**

	Transformer)	

14.0 Other Provisions: Earthing, Illumination, Hooter & Smoke Detector

14.1.1	Earth bus connection brought out of package substation enclosure to earth pad for connection to earth pit	a) Two earth pads for RMU, transformer & LV compartment each. b) Two earth pads for transformer neutral
14.1.2	Earth bus size	50 x6 GI flat
14.1.3	Earth bus fault current capacity	26.3kA for 1 sec
14.1.4	Earth connection of all covers, doors & structural parts to GI bus	By metallic jumper connection
14.1.5	Earth connection of RMU, ACB & transformer body parts to GI bus	By two numbers of 50x6mm GI flat per equipment
14.1.6	Earth bus identification	Shown by letter 'E'
14.2.1	RMU, transformer & LV compartment illumination	By 36w CFL fixture controlled through SPMCB & door limit switch
14.2.2	RMU, transformer & LV compartment power socket	5/15amp 3 pin socket through 15 amp SPMCB
14.24	Smoke Detector in each compartment	Minimum 02 no's Smoke Detectors in each LT, HT and Transformer compartment with potential free auxiliary contact for tripping the RMU, Alarm and SCADA. All detectors shall be wired upto controller cum alarm unit suitable. **[R3]**
14.25	Hooter	Required with timer reset for operator alarm on opening of PSS door

15.0 Labels & painting

15.1	Name plate on package enclosure	Fixing by rivet only
15.1.1	Material	Anodized aluminum 16SWG / Stainless Steel (SS) **[R3]**
15.1.2	Background	SATIN SILVER
15.1.3	Letters, diagram & border	Black
15.1.4	Process	Etching
15.2	Name plate details	Month & year of manufacture, transformer rating, purchaser name & order number, guarantee period, Ref. IS / IES No. Shall be provided inside enclosure as well as outside enclosure.**[R3]**

15.3	Labels for meters & indications	Anodized aluminium with white character on black background OR 3 ply Lamicoid
15.4	Danger plate on doors of RMU compartment & LV compartment	Etched on 16 swg anodised aluminium / SS plate with white letters on red background
15.5	BSES Insignia	a) 02 no's b) HV and LV side of PSS enclosure. c) Shall be etched on anodized aluminium 16SWG / SS plate. d) Details shall be finalized during drawing approval.
15.6	Enclosure painting surface preparation	Shot blasting or 7 tank chemical process
15.7	Enclosure painting external finish Powder coated epoxy polyester base	Hot dip galvanizing – 80 micron thick grade A, shade - RAL 7032, uniform thickness 60 micron minimum .
15.8	Enclosure painting internal finish	Powder coated epoxy polyester base grade A, shade -white, uniform thickness 80 micron minimum

16.0 Approved makes

16.1.0	RMU	For RMU accessories please refer RMU Specification part
16.4.0	Oil type transformer	Toshiba/Danish/ Schneider// or any other make approved by BRPL.[R7]
16.5.0	Dry type transformer	ABB/ Raychem / TMC/ or any other make approved by BRPL. [R7] [R8]
	Transformer core	Nippon/JFE/Posco
	Aluminium	Hindalco, Nalco, Sterlite, Birla Copper
	Copper	Birla Copper/Sterlite
	CT	Pragati/ECS/Kappa
	Resin	Huntsmen
16.6.0	Pressure relief valve	Sukrut / VIAL
16.7.0	Bushings make	Baroda bushing / CJI / Jaipur Glass
16.8.0	Winding Temperature Indicator	Precimeasure/ Pecon
16.9.0	ACB	L&T / Schneider-MG / AREVA / GE / Siemens / ABB / C&S **[R7]**
16.10.0	MCCB	GE / Merlin Gerin / ABB / L&T/Siemens **[R7]**
16.11.0	APFC	
16.11.1	Switch	ABB / Siemens / L&T (Salzer)
16.5.2	HRC Fuse Links	Alstom / Siemens / L&T / GE
16.5.3	Load manager	L&T / Enercon / AE / DUCATI / Phasetrac M-40 / TAS POWERTECH

16.5.4	APFC relay	Beluk / ABB / Fraco / Ducati/ TAS / POWERTECH
16.5.5	AC Contactors	ABB / Schneider
16.5.6	Push buttons / Actuator	L&T / Teknic / Siemens
16.5.7	MCB	ABB / L&T / Siemens/Schneider –MG
16.5.8	Capacitors	FRACO / DUCATI/ABB
16.5.9	Fans	EBM Nadi
16.6.0	Terminals	Connectwell / Elmex
16.7.0	Transformer Bushings (HV side)	Euromold (Nexan)/ Elmek/ H.J. International/ Pfisterer any other vendor approved by BSES
16.8.0	Termination kits for RMU	3m/ Raychem/ Denson
16.9.0	Termination kits for Transformer	3M/ Raychem/ Denson / any other make approved by BSES
16.9.1	Cold applied cable boots	3M/ Raychem

17.0 Quality assurance

17.1	Vendor quality plan	To be submitted for purchaser approval for all components listed in clause 4.0 For transformer, RMU & APFC panel sub vendor quality plan to be submitted.
17.2	Inspection points in quality plan	To be mutually identified & agreed
17.3	Quality – Process Audits	BSES shall carryout vendor process audits.
17.4	Field quality plan	Bidder to submit field quality plan along with the bid
17.5	Spare part list	Bidder to submit detailed spare part list along with the bid
17.6	Maintenance manual	Bidder to submit maintenance manual along with the bid

18.0 Inspection & testing

18.1	Type test as per IS / IEC	a) Only type tested quality equipment(s) shall be offered. b) Type test certificates mentioned in this clause shall be submitted along with offer for scrutiny c) The test report should not be more than 5years old. d) Type test and special tests for Transformer (from CPRI/ERDA) shall include the following **[R7]:** i) Impulse withstand test on all three HV limbs of the transformers for chopped wave as per IS 2026 ii) Temperature rise test as per IS 2026 iii) Air pressure test for sealed transformers asper IS 1180 iv) Pressure and Vacuum test on tank v) Dynamic & Thermal (3 sec) Short Circuit Test

		as per IS. vi) Measure of zero seq. impedance (Cl. 16.10 IS 2026 Part I). vii) Measurement of acoustic noise level (Cl. 16.12 of IS 2026 Part I). viii)Measurement of harmonic level on no load current. ix) Partial discharge test x) High voltage withstand test shall be performed on the auxiliary equipment and wiring after complete assembly. e) If identical rating type test reports for transformers are not available vendor to carryout Short circuit withstand test (Dynamic and thermal (for 3 secs)), Lightning impulse test & temperature rise test without any additional cost.
18.1.1	Package substation assembly	As per IEC 62271-202
18.1.2	11kv RMU, transformer, ACB, MCCB, APFC system and capacitor units	As per relevant IS/ IEC, For RMU type test criteria refer RMU specification part
18.2	Routing tests	
18.2.1	Routine tests of PSS	As per IEC 62271-202
18.2.2	Routine tests of transformer, RMU, LT panel & APFC	As per relevant IS/ IEC , For RMU refer RMU specification part
18.3	Inspection and acceptance testing	a) Purchaser reserves the right to inspect /witness all tests on the meters at manufacture's works at any time, prior to dispatch, to verify compliance with the specification/ standards. b) Manufacturer should have all the facilities/ equipments to conduct all the acceptance tests during inspection. All the testing equipment should be calibrated. c) Stage and / or final inspection call intimation shall be given at least 15 days in advance to the purchaser. d) For RMU refer RMU specification part
18.3.1	Stage inspection of transformer	Purchaser shall inspect transformers at the core and coil assembly stage at the manufacturer's premises.
18.3.2	Final inspection of transformers	The sequence of testing shall be as follows a) Visual and dimension check for completely assembled transformer. b) Measurements of voltage ratio. c) Measurements of winding resistance at principal tap and two extreme taps. d) Vector Group and polarity test. e) *Measurements of insulation resistance and polarization index. f) Separate sources voltage withstand test.

		g) Measurement of iron losses and exciting current at rated frequency and 90%, 100% and 110% rated voltage. h) Induced voltage withstand test. i) Load losses measurement. j) Impedance measurement of principal tap (HV and LV) of the transformer. k) Measurement of Iron loss (to be repeated if type test are conducted). l) Measurement of capacitance and Tan Delta for HV and LV bushings and Tan Delta for transformer oil (for all transformers). m) Oil leakage test on assembled transformer n) Magnetic balance test. o) Power frequency voltage withstand test on all auxiliary circuits p) Measure of zero seq. impedance (Cl. 16.10 IS 2026 Part I). q) Measurement of acoustic noise level (Cl. 16.12 of IS 2026 Part I). r) Measurement of harmonic level on no load current. *Insulation resistance measurement shall be carried out at 5kV for HV and 1kV for LV. Value of IR should not be less than 2000 Mohms**[R7].** Polarization Index (PI = IR10min/IR1min) should not be less than 1.5 (If one minute IR value is above 5000 Mohms and it is not be possible to obtain an accurate 10 minutes reading, in such cases polarization index can be disregarded as a measure of winding condition.)
18.3.3	Final Inspection of package substation after complete assembly	As per IEC 62271-202 and relevant IS/ IEC of equipment. a) Visual check b) Dimensional and sheet thickness check c) Verification of Wiring & BOM d) Paint thickness inside and outside of PSS enclosure. e) Functional test i. Operation of switchgear and control gear. ii. Mechanical operation and alignments of PSS doors. iii. Fixing of insulating barriers. iv. Voltage indication check v. Checking of temperature and liquid level of the transformer. vi. Fitting of earthing devices. vii. Cable testing viii. Replacement of LTCT ix. Operation of transformer tap changer

		x. Operation of illumination system xi. Trip function of HV switchgear. f) IR test g) HV test on power circuit h) HV test on auxiliary circuits i) Operational and interlocks check
18.3.4	Acceptance Test of LT Panel / APFC Panel	a) Visual, dimension, wiring & BOM check. b) Operational check. c) IR Test. d) HV Test
18.4	Special acceptance tests	
18.4.1	Transformer	Temperature rise test shall be carried out on 01 no transformer of each rating randomly selected from the offered lot.
18.4.2	PSS	Temperature rise test of PSS along with transformer as per IEC 62271-202.
18.5	Right to waive off tests	Reserved by Purchaser

19.0 Shipping, Handling and Site support

19.1	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration
19.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
19.3	Packing Identification Label (Anodized Aluminum Plate)	On each packing case, following details are required:
		a) Individual serial number
		b) Purchaser's name
		c) PO number (along with SAP item code, if any) & date
		d) Equipment Tag no. (if any)
		e) Destination
		f) Manufacturer / Supplier's name
		g) Address of Manufacturer / Supplier / it's agent
		h) Description of PSS.
		i) Country of origin
		j) Month & year of Manufacturing
		k) Case measurements
		l) Gross and net weights in kilograms
		m) All necessary slinging and stacking instructions
19.4	Shipping	The seller shall be responsible for all transit damage due to improper packing.
19.5	Handling and Storage	a) Manufacturer instruction shall be followed. b) Detail handling & storage instruction sheet /

		manual to be furnished before commencement of supply.

20.0 Deviations

20.1	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification.

21.0 Drawings Submission

21.1.0	To be submitted along with bid	The seller has to submit following:
21.1.1	GA drawing (Complete assembly, RMU, transformer, LT panel + other items)	
21.1.2	BOM of Packaged substation	
21.1.3	Calculation for sizing of Transformer	
21.1.4	Sizing Calculation of busbar in support of its Guaranteed S.C. rating / Capability	
21.1.5	Guaranteed technical particulars (GTP) of Packaged substation in the format as per annexure 'C'	
21.1.6	Clause wise deviation sheet as per clause no. 20.0	
21.1.7	Catalogues & manuals for Package substation + RMU + Transformer + LT switchgear items + APFC	
21.1.8	User manual for Hermetically Sealed Transformers. The manual must be provided with, but not limited to, maintenance schedule, frequency & method of oil- sampling, procedures for oil-filling & oil-filtration, etc.	
21.1.9	Quality plan for Packaged substation.	
21.1.10	Type test reports as per clause 18.1 of this specification.	
21.1.11	Recommended spare parts and consumable items for five years of operation and spare parts catalogue with price list	
21.2.0	After award of contract, Seller has to submit following drawings for buyer's Approval (A) / Reference (R)	
21.3.1	Program for production and testing (A)	
21.3.2	GTP of Packaged substation as per annexure 'C' of this specification.	
21.3.3	Deviation sheet, in case of any deviations finalized in technical bid evaluation.	
21.3.4	Design calculations for transformer	
21.3.5	Detailed GA drawing(s) (Complete assembly, RMU, transformer, LT panel + meter box + other items)	
21.3.6	Wiring/ schematic drawings (Complete assembly, RMU, transformer, LT panel + APFC + meter box + other items)	
21.3.7	Drawing details of Name plates, danger plates, BSES insignia, instruction sheets etc.	
21.3.8	Drawings of cable cleats/ clamps.	
21.3.9	Foundation drawing(s).	
21.3.10	BOM of Packaged substation	
21.3.11	Quality plan Packaged substation, RMU, Transformer, LT panel, APFC (panel and	

	units etc.	
21.3.12	Installation, commissioning manual for all items in Packaged substation. (for information)	
21.3.13	Operation & maintenance manual for all items in Packaged substation. (for information)	
21.3.14	Transport / Shipping dimensions with weights, wheel base details, un tanking height	
21.4	Submittals required prior to dispatch	
21.4.1	As built Drawings	
21.4.2	Inspection and test reports, carried out in manufacturer's works	
21.4.3	Test certificates of all bought out items	
21.4.4	Operation and maintenance Instruction as well as trouble shooting charts/ manuals	
21.5	Drawing and document sizes	Standard size paper A3, A4
21.6	Number of Documents required at different stages	4 hard copies + 2 soft copies in CD Format at each stage
Note :	Duly signed & stamped copies of the drawings / documentation are required to be submitted to BSES for approval.	

Annexure A Service Conditions

The package substation shall be designed & tested to operate satisfactorily under following conditions -

Sr No	Description	Data by purchaser
1.	Location	Delhi
2.	Reference design ambient temperature	40°C for Delhi
3.	Maximum ambient temperature	50°C for Delhi
4.	Relative humidity	85% for Delhi
5.	Seismic zone	Zone IV for Delhi

Annexure B Technical Specification for transformer oil

Transformer oil shall be new and conform to the following requirements:

1.0 Codes & standards

Latest revision of following codes & standards with all amendments –

	Standard no	Title
1.1	IS 335	New insulating oils
1.2	IS 1783	Drums for oils

1.1 Properties

The insulating oil shall have following features [R7]:

S.No.	Item description	Specification requirement
2.1	Appearance of oil	Clear, free from sediment and suspended matter
2.2	Viscosity Max.	15 mm2 /s at 40°C 1800 mm2 /s at 0°C
2.3	Pour Point, Max	-10°C
2.4	Water content, Max	30 mg/Kg
2.5	Breakdown voltage	
i)	New unfiltered oil. Min.	30 kV
ii)	After filtration Min.	70 kV
2.6	Density Max.	0.895 g/ml at 20°C
2.7	Dielectric dissipation factor Max	0.005 at 90 °C,
2.8	Particle Content	Value to be provided by the vendor
2.9	Acidity Max	0.01 mg KOH/g
2.10	Interfacial tension at 27°C Min	40 mN/m
2.11	Total sulphur content	Value to be provided by the vendor
2.12	Corrosive sulfur	Not-corrosive
2.13	Potentially Corrosive sulfur	Not-corrosive
2.14	DBDS	Not detectable (<5 mg/kg)
2.15	Inhibitor	Not detectable (<0.01%)
2.16	Metal Passivator	Not detectable (<5 mg/kg)
2.17	Other addivites	Type and concentration of additives to

		be provided by the vendor
2.18	2-furfural and related Compounds content	Not detectable (<0.05 mg/kg) for each individual compound
2.19	Oxidation stability	
a)	Total acidity, Max	1.2 mg KOH/g
b)	Sludge Max	0.8%
c)	DDF at 90 °C, Max	0.5
2.20	Gassing Tendency	Value to be provided by the vendor
2.21	ECT	Value to be provided by the vendor
2.22	Flash point Min.	135°C,
2.23	PCA content Max	3%
2.24	PCB content	Not detectable (<2 mg/Kg)
2.25	Test	As per IS 335-2018

Annexure C Guaranteed Technical Particulars (Data by Supplier)

i. Bidder shall furnish the GTP format with all details against each clause.
ii. Bidder shall not change the format of GTP or clause description.
iii. Bidder to submit duly filled GTP in hard copy format with company seal.

Sr. No.	Description	Data to be filled by Manufacturer
1	Manufacturer Name	
2	Manufacturer Address	
2.1	Telephone no	
3	Manufacturer contact person	
4	Manufacturer brand name (Give catalogue reference)	
	Conformance to specification	Yes/No
	If NO for above, Submission of clause wise deviation sheet	Yes/No
5	**11kV RMU**	
1	11kV RMU, 630A	
2	Equipment make	
	Equipment type / brand name	
3	Conformance to design standards as per specification clause no 2.0 –	Yes/No

4	Conformance to specification clause no 3.0 to 17.0 –	Yes/No
5	If NO for pt 3 or pt 4 above, Submission of deviation sheet for each specification clause no –	Yes/No
6	Panel overall dimensions in mm	
	Width (measured from front)	
	Depth	
	Height	
7	Panel weight in kg	
8	Panel extensible on both sides – Yes / No	
9	Panel enclosure protection offered	
10	Panel tested for internal arc (Cable & other compartments) –Yes / No	
11	Heat generated by the panel in Kw	
12	Insulation level for complete panel	
12.1	Impulse withstand (Kv peak) -70kvp min	
12.2	Power frequency withstand (Kv rms) – 28kv min	
13	Bus bar	
13.1	Material & grade	
13.2	Bus bar cross section area in sq mm	
13.3	Bus bar rated current in amp i) at designed 50 deg.C ambient {R9} at 50 deg.C ambient	
13.4	Max temperature rise above reference ambient of 40 deg C	
13.5	Short time current withstand capacity for 3 seconds (in KA)	
13.6	Bus bar clearances in mm P-P / P-E	
13.7	Bus bar with insulation sleeve / barriers	
13.8	Bus bar support insulator type	
13.9	Bus bar support insulator voltage class	
13.10	Bus bar support insulator minimum creepage distance / mm	
13.11	Earth bus bar material	
13.12	Earth bus bar size	
14	**Circuit breaker type – SF6 or VCB**	
14.1	Rated voltage & frequency	
14.2	Rated current in amp	

14.3	Rated breaking current – KA rms symmetrical	
14.4	Short time withstand capacity in KA for 3 sec	
14.5	Rated making current - KA peak	
14.6	Breaker total opening time at rated breaking capacity (in milliseconds)	
14.7	Number of breaks per pole	
14.8	Total length of contact travel in mm	
14.9	No of circuit breaker operation cycles (close & open) guaranteed at rated current, Electrical endurance class	25% rated current -
		50% rated current -
		75% rated current -
		100% rated current -
14.10	No of breaker opening operations guaranteed at rated fault current, Electrical Endurance Class	
14.11	No of breaker mechanical operation cycles (close & open) guaranteed at zero current , Mechanical endurance class	
14.12	Contact material	
14.13	Operating mechanism – trip free	
	Manual Spring charge type	
14.14	Feeder circuit breaker (FCB) –VCB	
14.14.3	Closing coil wattage & rated DC voltage	
14.14.4	Trip coil wattage & rated DC voltage	
14.15	Transformer CT class, ratio & Vk	
15	**Load break switch type – SF6 or VCB**	
15.1	Rated voltage & frequency	
15.2	Rated current in amp	
15.3	Load break switch total opening time at rated current (in milliseconds)	
15.4	Number of breaks per pole	
15.5	Total length of contact travel in mm	
15.7	No of LBS close & open operation cycles guaranteed at	25% rated current -
		50% rated current -

		75% rated current -
		100% rated current -
15.8	No of LBS making operations guaranteed at rated fault current, Electrical endurance class	
15.9	No of LBS close & open operations guaranteed at zero current, Mechanical endurance class	
15.10	Contact material	
15.11	Operating mechanism type	
15.13	Minimum permissible SF6 gas pressure (For SF6 type RMU only)	
15.14	Capacitor type cable voltage indication provided?	Yes / No
15.15	Operation counter provided	Yes/ No
16.1	Disconnect switch continuous rating (Amp)	
16.2	Disconnect switch Short time withstand rating -20kA for 3 sec minimum	Yes / No
16.3	One LBS open operation possible in the event of loss of SF6 gas	Yes/No
17.1	Cable termination – Height of power terminal from gland plate	Mm
17.2	Torque required for tightening terminal lug	
18	Mimic diagram, labels & finish as per cl no 12	Yes / No
19	Submission of RMU / component catalogue	Yes/No
20	Unit price for Conversion kit offered separately for converting the RMU from single cable termination design to double cable termination design	Yes / No
21	Earth Switch	
21.1	Minimum number of operations at no load- Mechanical Endurance class	
21.2	Making capacity endurance of earth switch – Electrical endurance class	
22	Self Powered Relay – Make / Model	As per make list (Relay shall be communicable with SCADA)
22.1	CT Input	
22.2	IDMT Setting Range 4 element – Over Current & Earth fault & steps	Overcurrent- Earth Fault-

		Instantaneous O/C- Instantaneous E/F-
22.3	Operating Time	Over Current – Curves Instantaneous
22.4	Pick up Current	
22.5	Resetting Current	
22.6	Relay Burden	
22.7	Time Accuracy	
22.8	Tripping Coil O/P – type & duration	
22.9	Fault Current Display	
22.10	No of Fault Current Latching with time stamping	
22.11	Display Facility / Type	
22.12	Operational Indicators	
22.13	Potential Free Output Contacts	
22.14	Thermal Withstand Capacity of Relay	
23	Fault Passage Indicator	Over Current and Earth Fault
23.1	CBCT	
a	Type	
b	Mounting Arrangement	
c	CT to indicator connection	
d	ID of sensor	
23.2	Earth Fault Indicator	
a	Sensing Current	
b	Sensing Time	
c	Indication	
d	Reset Time	
e	Resetting Facility	
f	Output Contact	
g	Contact Rating	
h	Aux Power Supply	
i	Degree of Protection	
j	Mounting Arrangement	
k	Ambient Temperature	
24	Current Transformer- Make	
24.1	Ratio	
24.2	Burden	

24.3	Accuracy Class		
25	Voltage Presence Indicator		
	Make		
	Rating		
	Model No		
26.8	Terminal Blocks, Disconnecting type fuses make		
6.0.0	**11kv cable**	from RMU to transformer	
6.1.0	Cable size 3CX150 sqmm AYFY	Yes/No	
6.2.0	Cable rated voltage - 11000v	Yes/No	
6.3.0	Cable short circuit current capacity for 1 sec	kA	
6.4.0	Type of insulation - XLPE	Yes/No	
6.5.0	Outer insulation sheath – PVC with armor	Yes/No	
6.6.0	Cable termination type & make		
7.0.0	**250 KVA/400KVA /630KVA/1000KVA hermetically sealed type transformer**		
7.1.0	Make		
7.2.0	Type - Oil immersed, core type, step down	Yes/No	
7.3.0	Transformer continuous rating when placed in package substation enclosure	HV winding	LV winding
		KVA	KVA
7.4.0	Rated voltage (kV)	HV winding	LV winding
		11 KV	0.415 KV
7.5.0	Rated current	HV winding	LV winding
		Amps	Amps
7.6.0	Transformer vector group – Dyn11	Yes / No	
7.7.0	Impedance at principal tap rated current and frequency, ohm @75 °C	250KVA/400KVA & 630KVA - 4.5.0 % & 1000KVA-5% with IS tolerance **[R4]**	
7.7.1	Impedance at lowest tap	Ω	
7.7.2	Impedance at highest tap	Ω	
7.8.0	Resistance of the winding at 75°C in ohm	HV winding	LV winding
		Ω	Ω
7.9.0	Zero sequence impedance in ohm	HV winding	LV winding
		Ω	Ω
7.10.0	Guaranteed maximum losses at principal tap full load and 75°C without any positive tolerance, kW		
7.10.1	No load losses (max.)	KW	

7.10.2	Load losses (max.)	KW
7.10.3	Total losses (max.) at 50% and 100% load **[R4]**	KW
7.10.4	No load loss at maximum permissible voltage and frequency (approx.),	KW
7.11.0	Temperature rise over reference ambient	
7.11.1	Top oil by thermometer °C	35 0C
7.11.2	Winding by resistance °C	40 0C
7.12.0	Efficiency	at 75°C and unity power factor
7.12.1	at 100% load	
7.12.2	at 50% load	
7.12.3	at 25% load	
7.13.0	Efficiency	at 75°C and 0.8 power factor lag
7.13.1	at 100% load	
7.13.2	at 50% load	
7.13.3	at 25% load	
7.14.0	Load and power factor at which Maximum efficiency occurs	
7.15.0	Regulation at full load at 75°C	
7.15.1	at unity power factor	
7.15.2	at 0.8 power factor lagging	
7.16.0	Regulation at 110% load at 75°C	
7.16.1	at unity power factor	
7.16.2	at 0.8 power factor lagging	
7.17.0	Tapping	Off circuit
7.17.1	Capacity	Full capacity
7.17.2	Range-steps x % variation	
7.17.3	Taps provided on HV winding	Yes / No
7.17.4	Rated current of rotary switch 100Amp	Yes / No
7.18.0	Transformer Tank	Corrugated plate tank
7.18.1	Cooling	ONAN
7.18.2	Tank material	Robust mild steel plate without pitting and low carbon content
7.18.3	Thickness of sides mm	
7.18.4	Thickness of bottom mm	
7.18.5	Thickness of cover mm	
7.18.6	Tank designed and tested for Vacuum, Pressure (Ref: CBIP Manual)	Yes/ No
7.18.7	Vacuum mm of Hg. / (KN/m^2)	
7.18.8	Pressure mm of Hg.	Twice the normal head of oil / normal pressure + $35kN/m^2$ whichever is lower, As per CBIP

7.18.9	Is the tank lid sloped?	Yes / No
7.18.10	Inspection cover provided	Yes / No
7.18.11	Location of inspection cover	Yes / No
7.19.0	Core	
7.19.1	Core material grade	Premium grade minimum M3 or better **[R4]**
7.19.2	Core lamination thickness	mm
7.19.3	Insulation of lamination	With insulation coating on both sides
7.19.4	Design flux density at rated condition at principal tap, Tesla	
7.19.5	Maximum flux density at 12.5 %**[R4]** over excitation / over fluxing,	1.9 Tesla
7.19.6	Equivalent cross section area	mm^2
7.20.0	Guaranteed No Load current at 100% rated voltage.	
7.20.1	HV	Amps
7.20.2	LV	Amps
7.21.0	Guaranteed No Load current At 110% rated voltage.	
7.21.1	HV	Amps
7.21.2	LV	Amps
7.22.0	Winding	
7.22.1	Type of Winding	
7.22.1	HV	
7.22.2	LV	
7.22.2	Conductor material	Electrolytic Copper
7.22.3	Current density (HV/LV)	Maximum allowed 3.0 A per mm^2.
7.22.4	Gauge/area of cross section of conductor	
	HV	mm^2
	LV	mm^2
7.22.5	Insulating material	type & thickness in mm
	HV Turn	mm
	LV Turn	mm
	LV Core	mm
	HV - LV	mm
7.23.0	Transformer insulation Polarization Index value (Min 1.5	
7.24.0	Transformer insulation IR value for HV winding (Min 2000Mega Ohm)	
7.25.0	Minimum design clearance, mm	

7.25.1	HV to earth in Air	
7.25.2	HV to earth in oil	
7.25.3	LV to earth in Air	
7.25.4	LV to earth in oil	
7.25.5	Between HV & LV in Air	
7.25.6	Between HV & LV in oil	
7.25.7	Top winding and yoke	
7.25.8	Bottom winding and yoke	
7.26.0	Transformer Insulating oil	
7.26.1	Quantity of oil	Ltrs
7.26.2	In the Transformer tank	
7.26.3	In each radiator	
7.26.4	Total quantity	
7.26.5	10% excess oil furnished?	Yes / No
7.26.6	Type of Oil	
7.27.0	Bushing / Support Insulator	
7.27.1	Make	
7.27.2	Type	
7.27.3	HV side	
7.27.4	LV side	
7.27.5	Reference Standard	
7.27.6	Voltage class, kV	
	HV side Bushing/ Support Insulator	12 kV
	LV side line and neutral bushing/ Support insulator	1.1 kV
7.27.7	Creepage factor for all bushing / Support Insulator mm/KV	31 mm / kV
7.27.8	Rated thermal short time current	
	HV bushing	KA
	LV line and neutral bushing	KA
7.27.9	Weight, Kg	
	HV bushing	KG
	LV line and neutral bushing	KG
7.27.10	Free space required for bushing removal	Mm
	HV bushing	
	LV line and neutral bushing	
7.28.0	HV Termination arrangement	To 3CX150 mm^2 AYFY 11KV By screened separable connector kit
7.28.1	Phase to phase clearance ,	mm
7.28.2	Phase to earth ,	mm
7.29.0	L.V termination arrangement	To 100x12 mm for phase &

		neutral	
7.29.1	Phase to phase clearance,	25 mm minimum	
7.29.2	Phase to earth clearance ,	25 mm minimum	
7.30.0	Current Transformer on LV phases		
7.30.1	Type		
7.30.2	Make		
7.30.3	Reference Standard		
7.30.4	CT Ratio		
7.30.5	Burden, VA		
7.30.6	Class of Accuracy / ISF		
7.30.7	CT terminal box size		
7.31.0	Pressure release device on tank - make		
7.31.2	Minimum pressure the device is set to rupture		
7.32.0	Fittings Accessories Each Transformer furnished as per Clause 7.3.0	Yes/No	
7.33.0	Painting: as per clause for the transformer, cable boxes, Marshalling box	Yes/No	
7.34.0	Over all transformer dimensions		
7.34.1	Length	mm	
7.34.2	Breadth	mm	
7.34.2	Height	Mm	
7.35.0	Weight data		
7.35.1	Core	KG	
7.35.2	Winding	KG	
7.35.3	Frame	KG	
7.35.4	Tank	KG	
7.35.5	Weight of oil in Tank	KG	
7.35.6	Total Transport weight of the transformer	KG	
7.36.0	Transformer total oil volume	liters	
8.0.0	**250/400/630/1000KVA Cast Resin Transformer**		
8.1.0	Make		
8.2.0	Type- Cast Resin Dry Type	Yes / No	
8.3.0	Transformer continuous rating when placed in package substation enclosure	HV winding	LV winding
		KVA	KVA
8.4.0	Rated voltage (kV)	HV winding	LV winding
		11 KV	0.415 KV
8.5.0	Rated current	HV winding	LV winding

		Amps	Amps
8.6.0	Transformer vector group – Dyn11		Yes / No
8.7.0	Impedance at principal tap rated current and frequency, ohm @130°C		5.0 % with IS tolerance
8.7.1	Impedance at lowest tap		Ω
8.7.2	Impedance at highest tap		Ω
8.8.0	Resistance of the winding at 130°C in ohm	HV winding	LV winding
		Ω	Ω
8.9.0	Zero sequence impedance in ohm	HV winding	LV winding
		Ω	Ω
8.10.0	Guaranteed maximum losses at principal tap full load and 130°C without any positive tolerance, kW		
8.10.1	No load losses (max.)		KW
8.10.2	Load losses (max.)		KW
8.10.2	Total losses (max.),		KW
8.10.4	No load loss at maximum permissible voltage and frequency (approx.),		KW
8.10.5	Total stray loses @ 130° C		
8.11.0	Temperature rise over reference ambient		
8.11.1	Winding by resistance: Outside the PSS enclosure / inside the PSS enclosure $_0$ C		80°C/ 90°C
8.11.2	Maximum hot spot temperature, Deg. C		°C
8.12.0	Efficiency		at 130°C and unity power factor
8.12.1	at 110% load		%
8.12.2	at 100% load		%
8.12.2	at 80% load		%
8.12.3	at 60% load		%
8.12.4	at 40% load		%
8.12.5	at 20% load		
8.13.0	Maximum hot spot temperature, Deg. C		at 130°C and 0.8 power factor lag
8.13.1	Efficiency		%
8.13.2	at 110% load		%
8.13.3	at 100% load		%
8.13.4	at 80% load		%

8.13.5	at 60% load	%
8.13.6	at 40% load	%
8.14.0	Maximum efficiency at 130°C	%
8.14.1	% Load and power factor at which it occurs	
8.15.0	Regulation at full load at 130°C	
8.15.1	at unity power factor	
8.15.2	at 0.8 power factor lagging	
8.16.0	Regulation at 110% load at 1300 C	
8.16.1	at unity power factor	
8.16.2	at 0.8 power factor lagging	
8.17.0	Core	
8.17.1	Core material grade	Premium grade minimum M3 or better **[R4]**
8.17.2	Thickness of lamination mm	mm
8.17.3	Insulation of lamination	
8.17.4	Design Flux Density at rated condition at principal tap, Tesla- 1.6 Tesla (Max)	
8.17.5	Maximum flux density at 10 % over excitation /overfluxing, Tesla -1.73Tesla (Max)	
8.17.6	Equivalent cross section area	
8.18.0	Guaranteed No Load current At 100% rated voltage , Amps	
8.18.1	HV	
8.18.2	LV	
8.19.0	Guaranteed No Load current At 110% rated voltage, Amps	
8.19.1	HV	
8.19.2	LV	
8.20.0	Type of Winding	
8.20.1	HV	
8.20.2	LV	
8.20.3	Conductor material	
8.20.4	Current density Amps/sqmm	
	HV winding	
	LV winding	
8.20.5	Gauge/area of cross section of conductor, sqmm	
	HV	
	LV	
8.21.0	Tapping - Off Ckt	Yes / No
8.21.1	Capacity	Full Capacity

8.21.2	Range- steps X % variation		
8.21.3	Taps provided on HV winding		Yes / No
8.21.4	Tap link Current rating , A		
8.22.0	Insulating material and thickness	Material	Thickness
8.22.1	HV Turn		mm
8.22.2	LV Turn		mm
8.22.3	LV to Core		mm
8.22.4	HV to LV		mm
8.23.0	Minimum design clearance, mm		
8.23.1	HV to earth in Air		mm
8.23.2	LV to earth in Air		mm
8.23.3	Between HV & LV in Air		mm
8.23.4	Top winding and yoke		mm
8.23.5	Bottom winding and yoke		mm
8.24.0	Bushing / Support Insulator		
8.24.1	Make		
8.24.2	Type		
8.24.3	Reference Standard		
8.24.4	Voltage class, kV		
8.24.5	HV side Bushing / Support insulator		
8.24.6	LV side line and neutral bushing / Support insulator		
8.24.7	Creepage factor for all bushing		mm / KV
8.24.8	Weight		KG
8.24.9	HV bushing / Support insulator		
8.24.10	LV line and neutral bushing / Support insulator		
8.24.11	Free space required for bushing / Support insulator removal, mm		
8.24.12	HV bushing / Support insulator		
8.24.13	LV line and neutral bushing / Support insulator		
8.25.0	HV Termination arrangement		Suitable for 3CX150 mm^2 AYFY 11KV
8.25.1	Phase to phase clearance		mm
8.25.2	Phase to earth clearance		mm
8.25.3	HV side bus bar size		
8.25.4	HV Termination height		Mm
8.26.0	L.V termination arrangement		Suitable to 100x12 mm for phase & neutral
8.26.1	Phase to phase clearance,		25 mm minimum
8.26.2	Phase to earth clearance ,		25 mm minimum

8.26.3	LV side bus bar size	
8.26.4	LV Termination Height	Mm
8.27.0	Current Transformer on LV phases	
8.27.1	Type	
8.27.2	Make	
8.27.3	Reference Standard	
8.27.4	CT Ratio	
8.27.5	Burden, VA	
8.27.6	Class of Accuracy	
8.28.0	WT scanner terminal box size	
8.29.0	Alarm and Trip contact ratings of protective devices	
8.29.1	Rated / making/ breaking currents , Amp @ Voltage for	
8.29.2	Winding temperature scanner	
8.30.0	Fittings and Accessories as per Cl. 7.19 provided	(YES / NO)
8.31.0	Over all transformer dimensions	
8.31.1	Length	mm
8.31.2	Width	mm
8.31.3	Height	mm
8.32.0	Weight data	
8.32.1	Core	KG
8.32.2	Frame parts, kG	KG
8.32.3	Core and frame, kG	KG
8.32.4	Total Winding, kG	KG
8.32.5	Core , Frame, Winding, kG	KG
8.32.6	Enclosure, kG	KG
8.32.7	Total Transport weight of the transformer, kG	KG
8.32.8	Total weight of the transformer with all accessories	KG
8.33.0	Shipping Data	
8.33.0	Weight of heaviest package, kG	KG
8.33.0	Dimensions of the largest package (L x B x H)	mm
8.34.0	Surge Arrestor requirement	
8.34.1	Type	
8.34.2	System Voltage , kV rms	
8.34.3	Rated Voltage of Arrestor, kV rms	
8.34.4	Continuous operating voltage , kV rms	
8.34.5	Maximum Continuous operating voltage, kV	

	rms	
8.34.6	Nominal Discharge Current, kA peak	
8.34.7	Energy Absorption Capability, kJ/kV	
8.34.8	Creepage factor	
8.34.9	Reference std	
8.35.0	WTI Scanner Details	
8.35.1	Make	
8.35.2	Model no.	
8.35.3	No of Channel / Input	
8.35.4	Manual submitted	
9.0.0	Low voltage bus bar system	To connect transformer LV side to ACB & to MCCB
9.1.0	Bus bar material tinned copper	Yes / No
9.2.0	Bus bar size	sqmm
9.3.0	Bus bar continuous current rating	Amp
9.4.0	Bus bar insulator voltage class	kV
9.5.0	Bus bar droppers size from ACB to MCCB (40x6 tinned copper)	
9.6.0	Maximum bus bar temperature rise	
10.0.0	ACB, MCCB	As per IS 13947
10.1.0	ACB make	
10.1.1	ACB rated voltage 415v +/- 10%	
10.1.2[R7]	ACB 4 pole	Yes / No
10.1.3	ACB continuous current capacity at 415v 50Hz, at 50 deg C	amp
10.1.4	ACB short circuit breaking capacity Ics =Icu = 50kA minimum	kA
10.1.5	ACB SC making current capacity 100kAp	kA peak
10.1.6	ACB short time current withstand capacity for 1 sec (Icw= 50kA)	kA
10.1.7	ACB rated impulse withstand voltage for main & aux circuit in kv	
10.1.8	ACB closing time in ms	
10.1.9	ACB opening time in ms	
10.1.10	Guaranteed number of close & open operations at no load	
10.1.11	Guaranteed number of close & open operations at rated load	
10.1.12	ACB dimensions	
10.1.13	ACB operating mechanism -Trip free, anti pumping type, manual as well as motor	Yes / No

10.1.14	Spring charging motor supply	volt
10.1.15	Close & trip coil supply	volt
10.1.16	ACB utilization category -B as per IS	
10.1.17	ACB indications - ON, OFF & TRIP	
10.1.18	ACB operation - manual - ON, OFF by push buttons	
10.1.19	ACB operation – electrical - ON, OFF by TNC switch	
10.1.20	ACB overload, short circuit & earth fault protection - By static or micro processor based releases	
10.1.21	Inbuilt CT burden, ration & class	
10.1.22	Overload release setting range	
10.1.23	Short circuit release setting range	
10.1.24	Earth fault release setting range	
10.1.25 **[R7]**	Display & Event Log	Display Require , Min last 10 nos fault event log req
10.2.0	MCCB make	
10.2.1 **[R7]**	MCCB type -3 pole, one break / pole	Yes / No
10.2.2	MCCB - On & OFF by Manual handle	Yes / No
10.2.3	MCCB Neutral connection - Fully isolable link sized for rated current	
10.2.4	MCCB rated voltage 415v +/- 10% at 50Hz	
10.2.5	MCCB rated continuous current at 50deg C(after derating)(400 amp & 630A MCCB as per enquiry)	400/630 amp
10.2.5(i){R6]	De rating of MCCB(0% at 50 deg C)	Yes / No
10.2.6	MCCB 3 ph short circuit breaking capacity Ics = Icu =36kA	
10.2.7	MCCB 3 ph short circuit withstand capacity, Icw =8kA for 1 sec	
10.2.8	MCCB SC making current capacity	
10.2.9	MCCB rated insulation level	
10.2.10	MCCB mechanical & electrical endurance as per IS 13947 / IEC	
10.2.11	MCCB category of duty - B as per IS / IEC 947	Yes / No
10.2.12	MCCB indications -ON, OFF & TR	
10.2.13	MCCB protection – Microprocessor release + earth fault	
10.2.14[R6]	Tripping characteristic required	

a	Overload setting- Range 60-100%In (Set on 95%)	
b	Short Circuit setting- Range 200-1200%In (Set on 300%)	
c	Earth fault setting To be provided	
10.2.15R6]	MCCB Housing- Thermoplastic material resistant to fire & abnormal heat , non hygroscopic	
10.2.16R6]	MCCB Terminal- Silver coated copper with phase barriers, spreader terminals & shrouds	
10.2.16 R6]	MCCB Spreader size & material-	
	Minimum-50(W)X50(L)X10(D)mm- Cu suitable for bimetallic joint i.e. for aluminium bus/cable lug	
10.2.17[R6]	MCCB Clearances in air- As per table XIII of IS 13947-1	
10.2.18[R6]	MCCB temperature rise limits - As per table 2 & 3 of IS 13947-1	
10.2.19[R6]	MCCB Ingress Protection- IP2X Minimum (pollution degree minimum 2)	
10.2.20 [R6]	MCCB additional features	Sealing/padlocking of operating knob in OFF position Sealing/padlocking of operating knob in OFF position isolation suitable with positive contact
10.3.0	Connection to ACB main bus by Cu bar with double PVC insulation	Yes / No
10.3.1	For 400 amp MCCB	
10.3.2	For 630 amp MCCB	
10.4.0	Connection to outgoing cables by bus bar terminals suitable for 2x4CX300sqmm AYFY 1100 volt grade cable	
10.4.1	MCCB– 7 nos. for Type–I , 5 nos. for Type–II & 3 for Type-III & 630 Amp three phase + neutral link	(YES/ NO)
10.4.2	Only for Type II & III- Provisions in LT panel to increase LT outgoing by 02 no's by adding MCCB's in future.	(YES/ NO)
11.0.0	APFC system	
11.1.0	Rating of APFC system	KVAR
11.2.0	Rated voltage & frequency	Volts at 50Hz

11.3.0	Rated line current of APFC system	Amp
11.4.0	Rated capacitance	micro Farad
11.5.0	Capacitor steps – Type I: 12x25KVAR? Type II: 8 X 25 KVAR?	Yes / No
11.6.0	Rated current of each 25KVAR unit	Yes / No
11.7.0	Rated capacitance – 25KVAR unit	micro Farad
11.8.0	Three phase connection – star / delta	
11.9.0	Capacitor dielectric type –	APP / MPP
11.10.0	No of series group / capacitor unit	
11.11.0	No. of parallel elements / series group	
11.12.0	Thickness of PP film in micron	
11.13.0	Thickness of Al foil in micron	
11.14.0	No. of PP film layers	
11.15.0	Maximum voltage stress per each PP film layer	
11.16.0	Discharge device material	
11.17.0	Capacitor tank steel thickness	mm
11.18.0	Capacitor unit dimension (L x D x H)	
11.19.0	APFC dimensions in mm (L x D x H)	
11.20.0	APFC system weight in kg	
11.21.0	Heat generated by APFC in Kw with all capacitor steps ON	
11.22.0	Operation with over voltage 115% of rated voltage for 12 hours in a day	
11.23.0	Operation with harmonic distortion THD 5% voltage & current	
11.24.0	Maximum permissible over current of	
11.25.0	1.3 times rated current continuous	
11.26.0	Dielectric loss less than 0.2w / KVAR	
11.27.0	Guaranteed minimum capacitor switching operations (ON/OFF) per year	
11.28.0	Maximum temperature rise above ambient of 45 Deg C	Deg C
11.29.0	Residual voltage after de-energiszation & at 60 seconds	
11.30.0	Design life of capacitor unit	
11.31.0	APFC panel insulation level	
11.32.0	1 minute power frequency withstand	KV
11.33.0	Impulse withstand voltage	KVp
11.34.0	Main bus bar material / size (sqmm)	
11.35.0	Main bus bar rated current	

11.36.0	Main bus bar short time withstand	
11.37.0	CT make & accuracy class	
11.38.0	CT ratio & burden (VA)	
11.39.0	APFC relay make / type	
11.40.0	APFC relay catalogue enclosed?	Yes / No
11.41.0	Data logger make / type	
11.42.0	Data logger catalogue enclosed?	Yes / No
11.43.0	AC contactor make	
11.44.0	AC contactor rating	Amp
11.45.0	AC contactor utilization category as per IS	
11.46.0	100amp MCCB make	
11.47.0	100amp MCCB current breaking capacity Ics=Icu=35kA	
11.48.0	Copper wire size from MCCB to contactor & capacitor – 35sqmm Cu	
12.0.0	Energy meter box as per specification provided?	Yes / No
13.0	Enclosure for package substation	
13.1	Service conditions for outdoor use	Yes / No
13.2	Material for enclosure – Galvanised Sheet steel 2.5mm thick CRCA for all side doors, covers with painting	Yes / No
13.3	Enclosure construction -Frame supported construction with all doors, covers welded with steel channel ribs at every 1000mm minimum	Yes / No
13.4	Lifting lugs for site handling / lifting by crane - qnty	
13.5	Doors for RMU compartment & LV compartment with anti theft hinge minimum 3 nos., with lockable handle & with padlocking facility	Yes / No
13.6	Two side covers for transformer	Yes / No
	compartment bolted with Allen head type bolts to main frame	
13.7	Top & other side walls of enclosure welded sheet metal	
13.8	Removable canopy above top cover -2.5mm thick sheet metal with 10º slope	Yes / No
13.9	Enclosure integral steel base frame ‘I’ section size	
13.10	Base frame bottom support pads for fixing by bolt to foundation - minimum six numbers to rest on foundation	Yes / No

13.11	Enclosure compartments -separate compartments for RMU, transformer & LV switchgear/APFC	Yes / No
13.12	Separation between RMU & transformer compartment by sheet steel 2.5mm thick	Yes / No
13.13	Separation between transformer compartment & LV compartment by sheet steel 2.5mm thick	Yes / No
13.14	Degree of ingress protection against solids & water as per IS12063	
a	IP53 for RMU compartment	
b	IP34 for transformer compartment [R7]	
c	IP33 for LV compartment	
13.15	Louvers on side covers of transformer compartment & side walls of LV compartment with steel wire mesh welded from inside so as to meet IP requirement as above	Yes / No
13.16	Louver area on cover / side wall -1500mm height x 1500mm minimum	
13.17	Exhaust fans mounted for APFC system to discharge air in transformer compartment - Controlled by SPMCB & thermostat to operate above 35 deg C, 2x150CFM, 1 ph 230v 50Hz	
13.18	Gland plate for RMU compartment - 2.5mm thick MS plate suitable for 3x3c300sqmm AYFY 11kv cable	
13.19	Gland plate for LV compartment -2.5mm thick MS plate suitable for 10x4c400sqmm cable + 10x7c2.5sqmm cable	
13.20	Class of enclosure as per IEC 62271-202 = 10K	Yes / No
13.21	Overall dimensions of package substation (LxWxH)	In mm
13.22	Overall weight of package substation	Kg
14.0	Enclosure earthing & illumination	
14.1	Two earth bus connection brought out of package substation enclosure to earth pad for connection to earth pit -Two earth pads for RMU, transformer & LV compartment each -One earth pads for transformer neutral	
14.2	Earth bus size 50X 6 mm GI flat	
14.3	Earth bus fault current capacity 26.3kA for 1 sec	

14.4	Earth connection of all covers, doors & structural parts to GI bus by metallic jumper connection	Yes / No
14.5	Earth connection of RMU, ACB & transformer body parts to GI bus by two numbers of 50x6mm GI flat per equipment	
14.6	Earth bus identification shown by letter 'E'	Yes / No
14.7	RMU, transformer & LV Compartment illumination by 36w CFL fixture controlled through SPMCB & door limit switch	
14.8	RMU, transformer & LV compartment power socket - 5/15amp 3 pin socket controlled through 15 amp SPMCB	
14.9	Paint shade external for enclosure	
14.10	Paint shade internal for enclosure	
14.11	Paint material & thickness	
14.12	Name plate & labels as per specification provided?	Yes / No
14.13	Smoke Detector	Yes / No
14.13.1	Make	
14.13.2	No Of Aux Contacts	
14.14	Hooter	Yes / No
15.0	Type test report submitted with GTP for RMU, transformer, ACB, MCCB, APFC system?	Yes / No
15.1	GA drawing of package substation submitted with GTP?	Yes / No
15.2	Bill of material submitted with GTP?	Yes / No
15.3	Clause wise deviation to technical specification submitted?	Yes / No

Bidder / Vendor seal / signature ----------

Name of the bidder	
Address of bidder	
Name of contact person	
Telephone no & email id	

Annexure D - CRGO & Testing Points [R7]

In addition to the BSES specification following points to be verified during manufacturing/inspection.	
1	Transformer core shall be low loss, non-ageing, high permeability PRIME GRADE

	CRGO with M3 Grade or better with max thickness of 0.23mm and with max core loss of 1 W/Kg, perfectly insulated and clamped to minimize noise and vibrations.
2	Following stage inspections will be carried out by purchaser or by third party engineers appointed by BSES :
2.1	Verification & inspection of the mother coil at port & putting stamp & seal may be inspected by BSES.
2.2	Reconciliation of mother coil by checking stamp & seal at factory before slitting. One sample of CRGO to be sealed for testing at ERDA/CPRI. Following Tests shall be conducted on the sample: 1) Specific core loss measurement 2) Magnetic polarization 3) Magnetic permeability 4) Specific core loss measurement after accelerated ageing test 5) Surface insulation resistivity 6) Electrical resistivity measurement 7) Stacking factor 8) Ductility(Bend test) 9) Lamination thickness 10) Magnetization characteristics (B-H curve)
2.3	Bidder should have in house core cutting facility for proper monitoring & control on quality. In case it is done outside cutting shall be done in presence of BSES.
2.4	Following documents to be submitted during the stage inspection :
2.4.1	Invoice of supplier
2.4.2	Mills test certificates
2.4.3	Packing list
2.4.4	Bill of lading
2.4.5	Bill of entry certificates by customs
2.4.6	Core material shall be directly procured either from the BSES approved manufacturer or through their authorized service centre/distributor and not through any contractor.
2.5	Bidder should have hydraulic core lifting facility to avoid any jerk at the time of core building.
2.6	BSES may appoint recognized testing authority like CPRI /ERDA with their instruments & engineer's team and measure no load loss, load loss and percentage impedance of the transformer at supplier's works at our own cost. Bidder shall agree and give them full cooperation during their stay & testing at shop floor. The losses & impedance values so obtained will be considered as final.
2.7	Bidder should have in-house NABL accredited testing facility.

Annexure E Recommended spares (Data by supplier)

List of recommended spares as following

Sr No	Description of spare part	Unit	Quantity
1		No	
2		No	
3			

4			
5			
6			
7			

Annexure F: BOM for 250 kVA PSS [R7]

Bill of Material for 11kV, 250 kVA PSS with (2 X 2 X 2 mtr)		
A	3 Way RMU (2 LBS + 1 VCB)	1 No.
B	250 kVA Dry/Oil DT	1 No.
C	LT Switchgear	
	Incomer 400 A 4P LT ACB	1 No.
	Outgoing 250A 3P MCCB	2 No.
D	Outdoor Enclosure	
	Outdoor type enclosure having modular construction of CRCA sheet metal in corrugated type wall design for better heat dissipation and providing robust construction. The enclosure shall have IP54 degree of protection for HT & LT switchgear compartment & IP34 degree of protection for Transformer compartment. The enclosure exterior shall be painted with epoxy based powder paint (colour RAL 7032). Each compartment will be provided with the door and pad locking arrangement. Doors of transformer compartment are fitted with Arc reflectors from the inside for providing better safety. The Compartment illumination lamp with door operated switch shall be provided for each compartment.	1 Set
E	Height of all equipment (RMU,LT panel & DT) from FGL	300 mm above from FGL
F	No foundation requirement , base frame / Pad mounted	Req.
G	Smoke detector with flag type auxiliary relay	Req.
H	Other material like (MFM, Fire Ball, Cable sealing compound, Space for DT meter Installation, etc.)	As per Spec