SYRIAN ARAB REPUBLIC
MINISTRY OF ENERGY
PUBLIC ESTABLISHMENT FOR
TRANSMISSION AND DISTRIBUTION OF ELECTRICITY

(PETDE)

SPECIFICATIONS FOR 20/0.4 KV DISTRIBUTION TRANSFORMERS

OPEN TERMINAL BUSHINGS AND HERMETICALLY SEALED FULLY FILLED WITH OIL 100 UP 1600 KVA

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1. GENERAL

1.1 Instruction to tenderers

Tenderers are invited for the supply and delivery of distribution transformers to PETDE, Damascus, Syrian Arab Republic. The equipment offered shall comply with the requirements of the IEC standards applicable at the time of contract placement furthermore the technical requirements of this specification.
Tenderers are required to examine carefully the tender documents in order to ascertain the matters on which they will be deemed to have satisfied themselves and the risks and obligations the tenderer shall undertake.
The Schedules shall be completely filled in and shall form the contractual guarantee schedules.

1.2 Language

The offer and its enclosed documents and references shall be submitted in English.
The correspondence if abroad shall be in English and if inland shall be in Arabic.

1.3 Tenderer's qualifications and experience

The tenderer is required to state in his offer the manufacturer's experience in the design and manufacturing the equipment they have proposed. In particular the tenderer shall state:

- Manufacturer's annual production capacity for the last two years.
- Manufacturer's client reference list over the last two years.

1.4 Quality assurance

The manufacturer is required to assure his offered transformers according to international quality standard ISO 9001-(latest version certificate should be submitted).

1.5 Packaging

The type of packaging should be suitable for export and shipping to Syrian Arab Republic, should be robust of suitable dimension and strength so to provide complete protection for marine, truck or rail loading and transportation. Appropriate procedures shall be taken to prevent vibration or movement.

Packaging should be acceptable to the insurance company.

Each transformer should be packed within wooden crate provided with wooden base of suitable dimensions that secure protection distance between each packed transformer and another one consequently to protect it from shocks.
Each crate must contain one transformer only and must include a protected packing list fixed on the crate in addition to the packing list inside the crate.
Each crate must be marked clearly on its two sides with the followings:

- Purchaser name: 'PETDE'
- Contract number
- Delivery and shipment numbers
- Manufacturing date
- Name of Manufacturer
- Equipment:'20/0.4 KV distribution transformer'
- Main technical specifications: voltage ratio, rating, etc.
- Transformer serial number
- Gross weight
- Net weight

1.6 Tender technical data

A complete tender technical data shall include two copies (one of them original) of the following documents in English:

- Fully completed technical specification schedules , all associated drawings and documents required by these schedules
- Catalogues (original) ….

2. TECHNICAL SPECIFICATIONS

2.1 Introduction

This section covers the technical specifications for hermetically sealed fully filled with oil 3-phase distribution transformers having a voltage ratio of 20/0.4 kV. The transformers are to be used in Syrian Electrical Network, constructed in compliance with relevant IEC standards to an accredited quality control system and shall be suitable for use at the specified ambient conditions.

2.2 Applicable Standards

The transformer design shall comply with the requirements of the latest current edition of relevant IEC standards and with the specific technical requirements of this specification.
In particular the following IEC standards shall apply:

IEC60076:	Power transformers
IEC 60137:	Insulated bushings for alternating voltages above 1000 V
IEC 60296:	Specification for unused mineral insulating oils for transformers and switch-gear
IEC 60354:	Loading guide for oil-immersed power transformers

2.3 System Details and Service Conditions (General Data)

The performance of the transformers shall be guaranteed for the following operating, installation and environmental conditions of Syria.

<u>20 kV Distribution System</u>

- 20 kV $\pm$ 5%
- Three phases, three wires
- Earthed through an earthing transformer 20/0,4kV (Zn Yn11)
- Vector group of distribution transformer 20 kV/0,4 kV DYN11
- Maximum service voltage : 24 kV
- Rated frequency : 50 Hz
- Impulse withstand voltage level : 125 kV at 1.2/50 μs
- Short circuit apparent power of the system 500 MVA

Environmental Conditions

- Altitude above sea level: ≤2000 m
- Max. ambient temperature: 50 C°
- Min. ambient temperature: - 10 C°
- Average annual temperature: 35 C°
- Maximal temperature variation in one day: 20 C°
- Average max . relative humidity: 80% at 30 degree
- (Relative humidity - in some sites of Syria - up to 100% is possible)

The offered products should be suitable for use under semi - arid conditions as well as for use on coastal area.

2.4 Technical Requirements

2.4.1 Rating

Ratings shall be based on permissible winding temperature rises (as measured by resistance) and top-oil temperature rises (as measured by thermometer) with maximum ambient air temperature, as specified in 'General Data'.
The transformer shall have overload capabilities in accordance with IEC 354 (item 2-3).

All associated components of the transformer, including bushing and tap switches shall have overload capabilities not lower than the transformer with which they are associated.
The transformer shall be capable of providing full rated power at all tap positions.

2.4.2 Short circuit capability

Transformers together with all equipment and accessories shall be designed and constructed withstanding the thermal and dynamic effect of external short circuit under the condition specified in item 2.3 without damage.

2.4.3 Tank

The transformers must be equipped with flexible (variable volume) folded corrugated tank that is needed to accommodate the expansion and contraction of oil due to varying service condition.
The number, depth and length of corrugations are chosen to give safe dissipation of the internal heat generated during operation of transformer.
The tank cover is bolted and sealed to it.
There is one thermometer pocket on the tank cover for thermometer, also there are two lifting lugs on the cover for lifting and carrying the transformer.
The tank cover is equipped with a filling pipe which is high enough to ensure a safe oil filling level in the insulated elements lead-through bushings at all times.
In the lower side there is a device for draining and down sampling of the transformer oil.
The earthing screws M12 are provided for earthing the transformer, one is fitted at the bottom on the high voltage side.
The tank must have fixing at the bottom to prevent any movement of the active part during transportation.
Two base frames that carrying the bidirectional wheels and have four puling lugs are welded to tank bottom required for transformers capacity 200 up to 1600 KVA for transformers capacity 25 and 100 KVA not required.

After tank parts have been assembled by welding process, it is checked for leakage with control liquid and ultraviolet radiation. The tank with its sealed cover is capable to withstand over-pressure of 0.3 Bar

2.4.4 Cleaning and Painting:

All metal parts such as cover, tank, core clamping, etc. shot blasted first to eliminate all signs of rust, welding spatters, grease, oil and mil scale and to achieve a good abraded surface for the paint to hold for long period of time.

Painting of transformer can be done with flooding or electrostatic process. In the process three coats of paint are applied, one under coat, one intermediate and one top coat, each coat has a minimum 40μm thickness. In the electrostatic process one coat of paint with a minimum thickness of 80μm is applied. The transformers are delivered in the final color shade RAL 7023 Concrete gray.

Painting by hand and natural drying is not accepted.

The offerer should submit the method of painting in details.

2.4.5 Windings

The LV Windings shall be made of electrolytic copper foil or Rectangular copper conductor with the interlayer insulator papers. For capacities 100 and 200 kva , and Copper foil with diamond pattern papers as interlayer insulator For the remaining capacities

The HV Windings shall be made of enameled round or paper insulated rectangular electrolytic copper conductors and wounded in layers for capacities less than 16,000 kVA and foil or Rectangular copper conductor for 1600 Kva, the extension of tap changer steps is determined accurately by using full automatic winding machine.

The insulation of windings shall be designed to give full protection against dielectric voltage stresses.

Insulation material meet the requirements of class A insulating's material withstanding maximum continuous operating temperature of 105 degrees of centigrade without loss of life.

The windings shall be one piece for each phase and made of electrolytic copper and shall comply in all respects with the relevant IEC standards.

The windings shall be designed such as they may be replaced with the minimum of difficulty.

The connection between the L.V bushing and the ends of the low voltage winding shall be made of flexible copper bar connected to the L.V bushing, and copper bar connected to the ends of the low voltage winding.

The tenderer shall submit a detailed description of the windings and the insulation proposed.

2.4.6 Neutral earthing

The neutral point of the transformer L.V windings shall be brought out to a separate fully insulated bushing and shall be suitable for solid connection to the earth stud.

2.4.7 Core

The core shall be of beltless type equipped with Three limps and two yokes, manufactured of high grade, grain oriented, silicon steel laminations with 0.23 or 0.27 mm thickness and low hysteresis losses.

Both sides of laminations have an insulation coating which provide the required interlamination resistance for decreasing eddy current losses.

For precisely cutting and stacking full automatic machine shall be used.

The core shall be designed to facilitate removal and replacement of the windings.

The core stack shall be internally earthed.

2.4.8 Insulating Oil

Insulating oil shall be in conformity with IEC60296-2003.
The use of PCBs as the dielectric medium is strictly prohibited.

2.4.9 Cooling

The transformer cooling system shall be ONAN.

2.4.10 Bushings

The bushings shall be designed in such a way as to allow easy dismantling.
3 HV porcelain bushings and 4 LV(same rated current) porcelain bushings will be fitted on the cover.
The bushings shall be designed to withstand the different thermal, electrical and mechanical stresses as well as all forces that may be produced by the short circuit currents.

2.4.11 Tap Changer

The transformer shall be equipped with an externally operated off-load tap changer on the high voltage side. The tapping range shall be ± 5 % in five equal steps. The tap changer shall be manually operated and lockable and shall be mounted such that operation is in a horizontal plane. The tap position number shall be durable and clearly visible.

2.4.12 Transformer Accessories

The transformer shall be equipped with at least the following:

a- <u>For transformers capacity 100 and 200 KVA:</u>

1- Oil level indicator
2- pressure relief valve
3- thermostat with contacts (alarm and tripe)
multi-functions device for items (1 , 2 , 3) is accepted
4- Rating plate
5- Thermometer pocket.
6- Oil drain plug at bottom
7- Two earthing terminal
8- Oil Filling pipe
9- Lifting eyes suitable for lifting by crane hook and ropes
10- Arcing horns on H.V. bushing (protection gap)
11- Off-load tape changer

b- <u>For transformers capacity 400 up to 1600 KVA:</u>

1- DGPT2 or DMCR Multifunction relays. These protective blocks have the contacts for over temperature (alarm and trip), over pressure and oil level detection (trip).
2- Rating plate
3- Thermometer pocket.
4- Oil drain plug at bottom
5 -Two earthing terminal
6 -Oil Filling pipe
7 -Four bidirectional wheels
8 -four puling lugs are welded to tank bottom

9 - Lifting eyes suitable for lifting by crane hook and ropes
10 - Arcing horns on H.V. bushing (protection gap)
11 - Off-load tape changer

2.4.13 Rating Plate

The transformer shall be provided with a rating plate of weatherproof and corrosion resistant material which shall be fitted in a position clearly visible to the operator.
The plate shall be indelibly marked in English. It shall include all information required by IEC 76-1.

3. TESTING

For approval of the technical characteristics and guarantied specifications, the transformers shall be subjected to some tests, which are categorized as routine, type and special tests.

A - Routine tests:

According to IEC 60076 standard, the following tests must be carried out for all units of the transformers

a- Measurement of winding resistance.
b- Measurement of voltage ratio and check of phase displacement.
c- Measurement of short circuit impedance and load losses.
d- Measurement of no-load losses and current.
e- Dielectric routine tests including the separate source AC voltage withstanding test and short duration induced over voltage withstanding test (ACSD) .

B - Type tests:

The following tests shall be carried out

a- Temperature rise test
b- Lightning impulse test

C - Special tests:

a- Determination of noise level according to IEC 60551 .
b- Oil leakage test
c- Overload test at 150 % rated current for one hour after temperature rise test (top oil temperature rise and winding temperature rise must be measured and recorded in the report test also hot spot temperature rise must be calculated and recorded on the report test)
d- Short Circuit Dynamic stability Test (test report from independent and accredited laboratory for similar transformer will be accepted).

3.1 Prototype testing

The contractor shall prepare one transformer as a prototype for inspection and testing during one month from the date of signing the contract.

The prototype will be inspected and tested according to A, B & C (type, routine and special tests). in presence of two PETDE representatives at the contractor's cost.

3.1.1 Prototype Visual-Inspection

The active part (winding and core) will be removed from the tank for inspection.

PETDE reserves the right to attend the prototype tests and the contractor will bear the costs of attendance of two PETDE representatives at such tests The costs borne by the contractor will include all the costs of return air fares from Damascus to the manufacturer's country, accommodation and subsistence expenses for one week in the country of the manufacturer's

In the case of rejection of the prototype the contractor will bear the same costs for inspection and test of the new prototype.
The prototype can be accepted only in case that the tests results are in compliance with or better than the contractual values and IEC requirements without tolerance for…

- No-load losses
- Load losses
- Top oil temperature rise
- Winding temperature rise
- Hot spot temperature rise
- Conductors' cross-section for HV and LV windings

If during inspection and testing it is demonstrated that the prototype does not comply fully with the requirements of the specification, the prototype will be rejected. In the event that the prototype is rejected the contractor will prepare a new prototype, as a second and a last chance, during one month only, at his own expense. The new prototype will be fully tested to the approved test schedule. In case of rejection of the new prototype. The contractual conditions will be applied.

3.2 Testing of production

3.2.1 production testing

All transformers shall be tested as Routine tests in according to IEC76 by the manufacturer himself (according to A).

3.2.2 Participation in testing Samples of the transformers from each delivery shall be tested in presence of PETDE representatives. The following tests shall be carried out :

3.2.2.1 Routine Tests: three transformers of the quantity to be delivered if the delivery quantity one hundred or less, five transformers of the quantity to be delivered if the delivery quantity more than one hundred and less than two hundred fifty, and ten transformers of the quantity to be delivered more than two hundred fifty.

3.2.2.2 Type Tests and special test :(for one transformer from each delivery) According to (B & C)

The contractor will bear the costs of attendance of two PETDE representatives for each delivery at such tests. The costs borne by the contractor will include all the costs of return air fares from Damascus to the manufacturer's country, accommodation and subsistence expenses for one week in the country of the manufacturers.

3.3 Acceptance, rejection and replacement

The acceptance will be in the Syrian warehouses subject to the following:

- Verifying that the delivered equipment complies with the requirements of the contractual documents and standards.
- If during inspection tests carried out or supervised by PETDE any material or equipment provided is proved defective or not manufactured according to the contractual specifications, PETDE shall have the right to reject such material or equipment.

4. Penalties and Rejection

If the transformer has passed the tests described in section. 3.3 except that the losses exceed the guaranteed limits PETDE may accept these transformers in accordance with the following penalties:

- If the no-load losses or load losses are higher than the guaranteed value by 15 % PETDE will reject the transformers.
- If the total losses exceed the guarantee value by 10 % PETDE will reject the transformers.

- If the no-load losses or load losses exceed the guaranteed value but are within the limits specified above the contractor will pay the following penalties:
  Iron losses: US$ 7.575 per Watt in excess
  Load losses: US$ 1.137 per Watt in excess

SCHEDULE A

QUALIFICATION

(Information to be provided with the Tender)

-The offerer must submit with his offer the following certificates and reports, offerer who doesn't submit one or more of these certificates or reports shall be rejected definitely. These certificates and reports should be for oil immersed distribution transformers not exceeding 2500 KVA with high voltage not more than 36 KV similar to the offered transformers as possible and produced by the same factory:

1- Full Routine and type test report by an independent testing qualified laboratory during the last five years.
2- Short-circuit dynamic test report (**special test)** shall be during the last ten years and supplied with address and fax. No. of the laboratory that issued this report.
3- A certificate indicating the annual turnover in USD during the last two years .
4- Reference list: outside country selling during the last two years with a list of customer's addresses including fax number.
5- Production capacity shall be not less than 2000 units yearly.
6- Quality assurance certificate issued by an independent body (ISO 9001), latest version
7- The offerer must submit detailed drawings of transformer and its parts and accessories (windings – the core-insulators…….) showing the dimensions and weights.

-All above reports and certificates should be signed and approved by the offerer and the manufacturer.

SCHEDULE A

MANUFACTURER AND PLACE OF MANUFACTURE

(Information to be provided with the Tender

Signed and approved by the manufacturer and the offerer)

Item	Manufacturer	Place of Manufacture
Transformer bushings -LV -HV		
Windings Insulation paper - LV - HV		
Magnetic core steel		
Transformer oil		
Winding copper -LV -HV		
Off -load Tap changer		
DGPT2 or DMCR multifunction relay		

SCHEDULE B

Equipment available inside the factory of the manufacturer Or will be done at sub-contractor outside the factory

Item No	Description	PETDE requirement		Offered Data
		Inside the factory	Sub-contractor outside the factory	
I	Full automatic machine for precisely cutting and stacking core steel	Preferable	Acceptable	
II	Three full automatic winding machine for H.V windings production	Must be	Not acceptable	
III	winding machine for L.V windings production -one full automatic machine for foil copper - tow for rectangular copper conductors with paper insulation	Must be	Not acceptable	
IV	Drying vacuum oven	Must be	Not acceptable	
V	Full automatic machine for corrugated tank sides	Preferable	Acceptable	
VI	Tank production and cleaning process : according to paragraphs 2.4.3 & 2.4.4	Preferable	Acceptable	
VII	Painting process : - electro static - or flooding and drying by oven	Preferable	Acceptable	
	- normal painting is not accepted	Not acceptable	Not acceptable	
VIII	Equipment available at the manufacture laboratory which needed to make the routine and type test :	Must be	Not acceptable	
A	Measuring devices watt hour meter , volt , Amp, …..meters) -power analyzer or measuring center	Must be	Not acceptable	
B	Double voltage generator	Must be	Not acceptable	
C	No load and load losses measurement It is done by: - special generator or auto transformer	Must be	Not acceptable	
D	Necessary equipment for insulation tests	Must be	Not acceptable	
IX	Oil sample laboratory	Must be	Not acceptable	
X	Impulse generator	Preferable	Acceptable	

The offerer must submit all the required data in detail (quantity and type)
Drawings must be submit with the offer
The offerer must submit all the necessary drawings for the transformer

SCHEDULE C1

TECHNICAL GUARANTEES AND PARTICULARS FOR 100 KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	kV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	kVA	**100**	
7	Maximum temperature rise above 50 C° ambient at rated power:			
7.1	Winding temperature rise	C°	≤ 55	
7.2	Top oil temperature rise	C°	≤ 50	
7.3	Hot spot temperature rise	C°	≤ 70	
8	**Losses :**			
8.1	No load losses at rated voltage	W	**≤ 145**	
8.2	Load losses at rated power At u.p.f. and 75 C°	W	**≤ 1475**	
8.3	Total losses at 75 C°	W	**≤ 1620**	
9	Impedance voltage (at 75C°, rated power and principle tapping)	%	4 ±10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	kV	50	
10.2	LV winding and bushing	kV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	kV_{peak}	125	
11.2	LV winding and bushing	kV_{peak}	6	
12	Winding resistance at 75 C° :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetising current in % of rated current at rated voltage	%	≤ ٢	
14	2 sec short circuit withstand current: -HV winding -LV winding	kA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	
16	Conductor cross-section :			
16.1	20 kv winding	mm^2	≥ 0.7	

Item No	Description	Units	PETDE Requirements	Offered Data
16.2	LV .winding	mm^2	≥ 58	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc. to IEC 60296-2003	
	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	$mm^{2/}S$ $mm^{2/}S$ C° C°	Max 12 Max 1800 Min 140 Max -30	
	-Appearance		Clear , free from sediment and suspended matter	
	-Acidity	mg/KOH/g	Max 0.01	
	-Density, at 20 C°	g/ml	Max 0.895	
	-Water Content	mg/kg	Acc to IEC	
	-Sludge		Max 0.8%	
	-DDF at 90 C°		≤ 0.005	
	- Breakdown voltage after laboratory treatment	KV	Min 70	
19	Physical parameters :			
19.1	Total weight	kg		
19.2	Active part weight	kg		
19.3	Weight of magnetic core	kg		
19.4	Weight of single 20 kv winding with insulating paper	kg		
	Weight of single 20 kv winding without insulating paper	kg		
19.5	Weight of single LV. Winding with insulating paper	kg		
	Weight of single LV. Winding without insulating paper	kg		
19.6	Weight of insulating Oil	kg		
19.7	Tank cover thickness	mm	≥ 4	
19.8	Tank bottom thickness	mm	≥ 4	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	corrugated thickness ≥1.2 other sides ≥ 3	
19.10	Weight of the Tank with cover	kg		
20	Dimension :			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		
21	Transformer Bushings :			
21.1	Material		Porcelain	
21.3	Rated current (MV/LV)	A	≥ 250/250	
21.4	Creepage distance (MV/LV)	mm	≥ 600/75	

Item No	Description	Units	PETDE Requirements	Offered Data
22	Maximum noise level	dB	50÷55	
23	Tappings :			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances :			
24.1	Between the windings and the tank	mm	≥ 30	
24.2	Between phases	mm	≥ 15	
25	Painting :		Acc. to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	micron	≥ 80μm	
26	Bidirectional wheels		Not required	

SCHEDULE C2

TECHNICAL GUARANTEES AND PARTICULARS FOR 200KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	KV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	KVA	**200**	
7	Maximum temperature rise above 50 C° ambient at rated power:			
7.1	Winding temperature rise	C°	≤ 55	
7.2	Top oil temperature rise	C°	≤ 50	
7.3	Hot spot temperature rise	C°	≤ 70	
8	**Losses :**			
8.1	No load losses at rated voltage	W	**≤ 255**	
8.2	Load losses at rated power At u.p.f. and 75 C°	W	**≤ 2400**	
8.3	Total losses at 75 C°	W	**≤ 2655**	
9	Impedance voltage (at 75°C, rated power and principle tapping)	%	4 ± 10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	KV	50	
10.2	LV winding and bushing	KV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	KV_{peak}	125	
11.2	LV winding and bushing	KV_{peak}	6	
12	Winding resistance at 75C° :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetizing current in % of rated current at rated voltage	%	≤ ٢	
14	2 sec short circuit withstand current : -HV winding -LV winding	KA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	
16	Conductor cross-section :			
16.1	20 kv winding	mm^2	≥ 1.4	

Item No	Description	Units	PETDE Requirements	Offered Data
16.2	LV .winding	mm^2	≥ 116	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc. to IEC 60296-2003	
	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	mm^2/S mm^2/S C° C°	max 12 max 1800 min 140 max -30	
	-Appearance		Clear , free from sediment and suspended matter	
	-Acidity	mg/KOH/g	Max 0.01	
	-Density, at 20 C°	g/ml	Max 0.895	
	-Water Content	mg/kg	Acc. to IEC	
	-Sludge		Max 0.8%	
	-DDF at 90 C°		≤ 0.005	
	- Breakdown voltage after laboratory treatment	KV	Min 70	
19	Physical parameters :			
19.1	Total weight	kg		
19.2	Active part weight	kg		
19.3	Weight of magnetic core	kg		
19.4	Weight of single 20 kv winding with insulating paper	kg		
	Weight of single 20 kv winding without insulating paper	kg		
19.5	Weight of single LV. Winding with insulating paper	kg		
	Weight of single LV. Winding without insulating paper	kg		
19.6	Weight of insulating Oil	kg		
19.7	Tank cover thickness	mm	≥ 4	
19.8	Tank bottom thickness	mm	≥ 4	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	corrugated thickness ≥1.2 other sides ≥ 3	
19.10	Weight of the Tank with cover	kg		
20	Dimension :			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		
21	Transformer Bushings :			
21.1	Material		Porcelain	
21.3	Rated current (MV/LV)	A	≥ 250/400	

Item No	Description	Units	PETDE Requirements	Offered Data
21.4	Creepage distance (MV/LV)	mm	≥ 600/75	
22	Maximum noise level	dB	≤ 55	
23	Tappings :			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances :			
24.1	Between the windings and the tank	mm	≥ 30	
24.2	Between phases	mm	≥ 15	
25	Painting :		Acc. to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	micron	≥ 80μm	
26	Bi-direction wheels		Acc. to paragraph 2.4.3	

SCHEDULE C3

TECHNICAL GUARANTEES AND PARTICULARS FOR 400KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	kV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	KVA	**400**	
7	Maximum temperature rise above 50 C° ambient at rated power:			
7.1	Winding temperature rise	C°	≤ 55	
7.2	Top oil temperature rise	C°	≤ 50	
7.3	Hot spot temperature rise	C°	≤ 70	
8	**Losses :**			
8.1	No load losses at rated voltage	W	**≤ 430**	
8.2	Load losses at rated power At u.p.f. and 75 C°	W	**≤ 3850**	
8.3	Total losses at 75 C°	W	**≤4280**	
9	Impedance voltage (at 75 C°, rated power and principle tapping)	%	6 ± 10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	kV	50	
10.2	LV winding and bushing	kV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	kV_{peak}	125	
11.2	LV winding and bushing	kV_{peak}	6	
12	Winding resistance at 75C° :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetizing current in % of rated current at rated voltage	%	≤1	
14	2 sec short circuit withstand current : -HV winding -LV winding	kA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	

Item No	Description	Units	PETDE Requirements	Offered Data
16	Conductor cross-section :			
16.1	20 kv winding	mm^2	≥ 2.7	
16.2	LV .winding	mm^2	≥ 231	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc to IEC 60296-2003	
18.1	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	mm^2/S mm^2/S C° C°	max 12 max 1800 min 140 max -30	
18.2	-Appearance		Clear , free from sediment and suspended matter	
18.3	-Acidity	mg/KOH/g	max 0.01	
18.4	-Density, at 20 C°	g/ml	max 0.895	
18.5	-Water Content	mg/kg	Acc to IEC	
18.6	-Sludge		max 0.8%	
18.7	-DDF at 90 C°		≤ 0.005	
18.8	- Breakdown voltage after laboratory treatment	KV	min 70	
19	Physical parameters :			
19.1	Total weight	kg		
19.2	Active part weight	kg		
19.3	Weight of magnetic core	kg		
19.4	Weight of single 20 kv winding with insulating paper	kg		
	Weight of single 20 kv winding without insulating paper	kg		
	Weight of single LV. Winding with insulating paper	Kg		
19.5	Weight of single LV. Winding without insulating paper	kg		
19.6	Weight of insulating oil	Kg		
19.7	Tank cover thickness	mm	≥ 6	
19.8	Tank bottom thickness	mm	≥ 6	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	≥ 1.2	
19.10	Weight of the Tank with cover	kg		
20	Dimension:			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		

Item No	Description	Units	PETDE Requirements	Offered Data
21	Transformer Bushings :			
21.1	Material		Porcelain	
21.3	Rated current (MV/LV)	A	≥ 250/1000	
21.4	Creepage distance (MV/LV)	Mm	≥ 600/75	
22	Maximum noise level	dB	≤ 60	
23	Tapping :			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances :			
24.1	Between the windings and the tank	mm	≥ 30	
24.2	Between phases	mm	≥ 15	
25	Painting :		Acc to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	micron	≥ 80	
26	Bi Directional wheels		Acc to paragraph 2.4.3	

SCHEDULE C4

TECHNICAL GUARANTEES AND PARTICULARS FOR 630KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	KV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	KVA	**630**	
7	Maximum temperature rise above50 C^o ambient at rated power:			
7.1	Winding temperature rise	C^o	≤ 55	
7.2	Top oil temperature rise	C^o	≤ 50	
7.3	Hot spot temperature rise	C^o	≤ 70	
8	**Losses :**			
8.1	No load losses at rated voltage	W	**≤ 600**	
8.2	Load losses at rated power At u.p.f. and 75 C^o	W	**≤ 5600**	
8.3	Total losses at 75 C^o	W	**≤6200**	
9	Impedance voltage (at 75 C^o, rated power and principle tapping)	%	6 ± 10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	kV	50	
10.2	LV winding and bushing	KV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	KV_{peak}	125	
11.2	LV winding and bushing	KV_{peak}	6	
12	Winding resistance at 75 C^o :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetising current in % of rated current at rated voltage	%	≤1	
14	2 sec short circuit withstand current : -HV winding -LV winding	kA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	

Item No	Description	Units	PETDE Requirements	Offered Data
16	Conductor cross-section :			
16.1	20 kv winding (J=2.5A/mm2)	mm^2	**≥ 4.2**	
16.2	LV .winding (J=2.5A/mm2)	mm^2	**≥ 364**	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc. to IEC 60296-2003	
	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	mm^2/S mm^2/S C° C°	max 12 max 1800 min 140 max -30	
	-Appearance		Clear , free from sediment and suspended matter	
	-Acidity	mg/KOH/g	Max 0.01	
	-Density at 20 C°	g/ml	Max 0.895	
	-Water Content	mg/kg	Acc. to IEC	
	-Sludge		Max 0.8%	
	-DDF at 90 C°		≤ 0.005	
	- Breakdown voltage after laboratory treatment	KV	Min 70	
19	Physical parameters :			
19.1	Total weight	Kg		
19.2	Active part weight			
19.3	Weight of magnetic core	Kg		
19.4	Weight of single 20 kv winding with insulating paper	Kg		
	Weight of single 20 kv winding without insulating paper	Kg		
19.5	Weight of single LV. Winding with insulating paper	Kg		
	Weight of single LV. Winding without insulating paper			
19.6	Weight of insulating Oil	Kg		
19.7	Tank cover thickness	mm	**≥ 6**	
19.8	Tank bottom thickness	mm	**≥ 6**	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	**≥1.2**	
19.10	Weight of the Tank with cover	kg		
20	Dimension :			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		

Item No	Description	Units	PETDE Requirements	Offered Data
21	Transformer Bushings :			
21.1	Material		Porcelain	
21.2	Rated current (MV/LV)	A	**≥ 250/1500**	
21.3	Creepage distance (MV/LV)	Mm	**≥ 600/75**	
22	Maximum noise level	dB	≤ 62	
23	Tapping :			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances :			
24.1	Between the windings and the tank	mm	≥ 30	
24.2	Between phases	mm	≥ 15	
25	Painting :		Acc. to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	Micron	≥ 80	
26	Bi-direction wheels		Acc. to paragraph 2.4.3	

SCHEDULE C5

TECHNICAL GUARANTEES AND PARTICULARS FOR 1000KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	kV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	kVA	1000	
7	Maximum temperature rise above50 C^o ambient at rated power:			
7.1	Winding temperature rise	C^o	≤ 55	
7.2	Top oil temperature rise	C^o	≤ 50	
7.3	Hot spot temperature rise	C^o	≤ 70	
8	**Losses:**			
8.1	No load losses at rated voltage	W	**≤ 770**	
8.2	Load losses at rated power At u.p.f. and 75 C^o	W	**≤ 9500**	
8.3	Total losses at 75 C^o	W	**≤10270**	
9	Impedance voltage (at 75 C^o, rated power and principle tapping)	%	6 ± 10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	kV	50	
10.2	LV winding and bushing	kV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	kV_{peak}	125	
11.2	LV winding and bushing	kV_{peak}	6	
12	Winding resistance at 75 C^o :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetizing current in % of rated current at rated voltage	%	≤1	
14	2 sec short circuit withstand current : -HV winding -LV winding	kA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	
16	Conductor cross-section :			
16.1	20 kv winding , (J=2.5A/mm2)	mm^2	≥ 6.7	

Item No	Description	Units	PETDE Requirements	Offered Data
16.2	LV .winding , (J=2.5A/mm2)	mm^2	≥ 578	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc. to IEC 60296-2003	
	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	$mm^{2/}S$ $mm^{2/}S$ C° C°	max 12 max 1800 min 140 max -30	
	-Appearance		Clear , free from sediment and suspended matter	
	-Acidity	mg/KOH/g	Max 0.01	
	-Density, at 20 C°	g/ml	Max 0.895	
	-Water Content	mg/kg	Acc. to IEC	
	-Sludge		Max 0.8%	
	-DDF at 90 C°		≤ 0.005	
	-Breakdown voltage after laboratory treatment	KV	Min 70	
19	Physical parameters:			
19.1	Total weight	kg		
19.2	Active part weight	kg		
19.3	Weight of magnetic core	kg		
19.4	Weight of single 20 kv winding with insulating paper	kg		
	Weight of single 20 kv winding without insulating paper	kg		
19.5	Weight of single LV. Winding with insulating paper	kg		
	Weight of single LV. Winding without insulating paper	kg		
19.6	Weight of insulating Oil	kg		
19.7	Tank cover thickness	mm	≥ 6	
19.8	Tank bottom thickness	mm	≥ 6	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	≥1.2	
١٩,١٠	Weight of the Tank with cover	kg		
20	Dimension:			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		

Item No	Description	Units	PETDE Requirements	Offered Data
21	Transformer Bushings:			
21.1	Material		Porcelain	
21.3	Rated current (MV/LV)	A	≥ 250/2000	
21.4	Creepage distance (MV/LV)	mm	≥ 600/75	
22	Maximum noise level	dB	≤ 64	
23	Tapping:			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances:			
24.1	Between the windings and the tank	mm	≥ 40	
24.2	Between phases	mm	≥ 15	
25	Painting:		Acc. to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	micron	≥ 80	
26	Bi-direction wheels		Acc. to paragraph 2.4.3	

SCHEDULE C6

TECHNICAL GUARANTEES AND PARTICULARS FOR 1600KVA

(Information to be provided with the Tender
Signed and approved by the manufacturer and the offerer)

Item No	Description	Units	PETDE Requirements	Offered Data
1	Name of manufacturer			
2	Country of origin			
3	Voltage ratio	kV	20/0.4	
4	Vector Group		Dyn11	
5	Method of cooling		ONAN	
6	Rated power when operated at the specified site conditions	kVA	**1600**	
7	Maximum temperature rise above50 C^o ambient at rated power:			
7.1	Winding temperature rise	°C	≤ 55	
7.2	Top oil temperature rise	°C	≤ 50	
7.3	Hot spot temperature rise	°C	≤ 70	
8	**Losses :**			
8.1	No load losses at rated voltage	W	**≤ 1200**	
8.2	Load losses at rated power At u.p.f. and 75 C^o	W	**≤ 14000**	
8.3	Total losses at 75 C^o	W	**≤15200**	
9	Impedance voltage (at 75 C^o, rated power and principle tapping)	%	6 ± 10% Acc To IEC60076	
10	Power frequency withstand voltage:			
10.1	20 kv winding and bushing	kV	50	
10.2	LV winding and bushing	kV	3	
11	Impulse withstand voltage 1.2/50 μs:			
11.1	20 KV winding and bushing	kV_{peak}	125	
11.2	LV winding and bushing	kV_{peak}	6	
12	Winding resistance at 75C^o :			
12.1	20 kv winding	Ω/phase		
12.2	LV winding	Ω/phase		
13	Magnetizing current in % of rated current at rated voltage	%	≤1	
14	2 sec short circuit withstand current : -HV winding -LV winding	kA		
15	Maximum flux density at normal voltage and frequency.	Tesla	≤ 1.7	
16	Conductor cross-section :			
16.1	20 kv winding , (J=2.5A/mm2)	mm^2	≥ 10.7	

Item No	Description	Units	PETDE Requirements	Offered Data
16.2	LV .winding , (J=2.5A/mm2)	mm^2	≥ 924	
17	Type and class of insulation:		Class A	
18	Transformer oil :		Acc. to IEC 60296-2003	
	- Viscosity at 40 C° - Viscosity at -30 C° - Flash point - Pour Point	$mm^{2/}S$ $mm^{2/}S$ ° C ° C	max 12 max 1800 min 140 max -30	
	-Appearance		Clear , free from sediment and suspended matter	
	-Acidity	mg/KOH/ g	Max 0.01	
	-Density, at 20 C°	g/ml	Max 0.895	
	-Water Content	mg/kg	Acc. to IEC	
	-Sludge		Max 0.8%	
	-DDF at 90 C°		≤ 0.005	
	- Breakdown voltage after laboratory treatment	KV	Min 70	
19	Physical parameters :			
19.1	Total weight	kg		
19.2	Active part weight	kg		
19.3	Weight of magnetic core	kg		
19.4	Weight of single 20 kv winding with insulating paper	kg		
	Weight of single 20 kv winding without insulating paper	kg		
19.5	Weight of single LV. Winding with insulating paper	kg		
	Weight of single LV. Winding without insulating paper	kg		
19.6	Weight of insulating oil	kg		
19.7	Tank cover thickness	mm	≥ 6	
19.8	Tank bottom thickness	mm	≥ 6	
19.9	Side Thickness (at least two longitudinally tank sides must be corrugated)	mm	≥1.2	
19-10	Weight of the Tank with cover	kg		
20	Dimension :			
20.1	Overall length	mm		
20.2	Overall width	mm		
20.3	Overall height	mm		
21	Transformer Bushings :			
21.1	Material		Porcelain	

Item No	Description	Units	PETDE Requirements	Offered Data
21.3	Rated current (MV/LV)	A	≥ 250/3000	
21.4	Creepage distance (MV/LV)	mm	≥ 600/75	
22	Maximum noise level	dB	≤ 66	
23	Tapping :			
23.1	Tapping range		± 2 × 2.5 %	
23.2	Number of taps		5	
24	Clearances :			
24.1	Between the windings and the tank	mm	≥ 40	
24.2	Between phases	mm	≥ 15	
25	Painting :		Acc. to paragraph 2.4.4	
25.1	Paint type : flooding and drying by oven or electrostatic		PETDE prefer electrostatic	
25.2	The Thickness	micron	≥ 80	
26	Bi-direction wheels		Acc. to paragraph 2.4.3	

List of Quantities
information to be provided with the tender

Item No	Description	Units	QTY	PRICE /$/			
				FOB		CFR	
				Unit	Total	Unit	Total
1	**100 KVA transformer**	Piece	**150**				
	200 KVA transformer	Piece	**150**				
	400 KVA transformer	Piece	**200**				
	630 KVA transformer	Piece	**100**				
	1000 KVA transformer	Piece	**100**				
	1600 KVA transformer	Piece	**100**				
2	Spare Parts:						
2.1	Set of three primary and secondary windings and must be supplied in sealed oil tank	Set	Two sets per capacity				
2.2	complete HV bushing (Each set must be 3 pieces)	Set	Two sets per capacity				
2.3	complete LV bushing (Each set must be 4 pieces)	Set	Two sets per capacity				
2.4	Off load tap changer	Piece	Three Pieces per capacity				
3	Living expenses of two representatives (engineers) to the contractor country to participate in the testing for one week for each delivery		2				
4	Living expenses of two PETDE engineers to attend the prototype test in the manufacture country for one week		2				