

Ministry of Electricity (MOE)  
Power Distribution Office  
Baghdad - IRAQ

SPECIFICATION No.	D-26
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# ***DISTRIBUTION TRANSFORMER***

## ***11 / 0.416 kV***

REVISION	YEAR 2013
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# DISTRIBUTION TRANSFORMERS

## 1- SCOPE OF THE TENDER :

Tenderer are invited for the design , manufacture , testing and supply of a 11000/416 volt, oil immersed copper winding outdoor type (Directly under the sun) transformers to be supplied complete with all necessary fittings , accessories off-load tap changer , insulating oil and spare parts . etc.

The transformer is to be hermetically sealed (without conservator tank) bolted cover with bushing insulators on both H.T and L.T sides for the following rating: 100, 250, 400, Box type for rating 630 and 1000 KVA. And a valid ISO 9001 certificate.

## 2- GENERAL REQUIREMENTS :

The transformers shall be of first class quality and design for continuous satisfactory operation as continuity of supply is of prime consideration. The design shall be allow all necessary precaution for the safety of operation and maintenance personnel. The transformers shall operate satisfactorily under variations of load, voltage or short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. All the equipment shall be designed to obviate the risk of accidental short circuit.

### 2-1 Climatic Conditions:

The materials used shall be suitable for the following climatic conditions prevailing at the site:

#### 2-1-1 Ambient temperature:

Highest maximum (in the shade) +55C for about 6 hrs a day.

Lowest minimum -10C

Maximum yearly average +30C

Maximum daily average +40C

#### 2-1-2 Solar Temperature:

Black objects under direct sunshine attain a temperature of 80 °C.

### **2-1-3 Air humidity :**

Maximum	92% at 40° C
Minimum	12%
Yearly average	44%

### **2-1-4 Sand storm:**

In general the atmosphere is dusty which may result in a layer of dust being deposited on all exposed surfaces. Also fine dust particles may penetrate even through minute openings.

## **2-2 Altitudes**

From sea level up to (1000m)

## **2-3 System Data:**

### **2-3-1** High voltage side:-

Nominal voltage	11000 Volts
Short circuit level	25 KA at 11000 volts
Frequency	50 HZ.
Highest system voltage	12000 volts
system	3- phase,3-wire with neutral isolated but provision is made for earthing through an earthing resistance of 21.1 ohms to limit the earth fault current to 300 Amp.

### **2-3-2** Low voltage side:-

Nominal voltage: 416/240 volts  
system

3-phase, 4-wire neutral  
solidly earthed.

Short circuit level

According to the short circuit level of H.T side and the rated power and impedance voltage of the transformer

#### **2-4 Standards:**

All the equipments shall be in accordance with the latest issue of the international Electro – technical commission (IEC specification).

#### **2-5 Deviation:**

The tenderer shall particularly mention in his tender all deviations from the specification described in these tender specification.

#### **2-6 Schedules:**

The tender shall duly fill in the schedules A&B of guaranteed technical particulars, prices, delivery and deviations attached to this specification. Incomplete tenders are liable to rejection.

#### **2-7 Guarantee:**

The tenderer shall confirm that the transformer guaranteed against all defects arising from faults design, materials and workmanship, for a period of (12) months from commissioning or (18) months from arrivals, whichever period expires earlier.

### **3- system composition**

The transformer shall operate in distribution systems where most of the network is overhead lines and comprising partly underground cable.

## 4- TECHNICAL SPECIFICATION

The transformers shall be copper winding. Hermetically sealed of the bolted cover and should have the following characteristics:-

Rated outputs ONAN .... 100, 250, 400, 630, and 1000 KVA.

Duty.....step-down, outdoor bushing type for 100,250,400, Box type for 630 & 1000 KVA (either steel box type or plug in type according to the tender documents).

Type .....wound, 3-phase

Rated voltage at no load .... H.V. 11kv L.V- 416 volt.

System frequency .....50HZ

Interphase Connection ... H.V. Delta L.V- star with neutral brought out.

Vector relation ship ..... Dyn 11

Type of Cooling .... ONAN

- ❖ Temperature rise .....( i ) 45 K in top oil by thermometer  
( ii ) 50 K in winding by resistance.
- ❖ The efficiency (at unity power factor and 100% of rated power) of the transformer should be not less than the following:
  1. 100 kVA ..... 98.1%
  2. 250 kVA ..... 98.6%
  3. 400 kVA ..... 98.7%
  4. 630 kVA ..... 98.8%
  5. 1000 kVA ..... 98.9%
- ❖ The duration of the short circuit to rise the temp. of windings from 105<sup>0</sup> C to 250<sup>0</sup> C should be not less than (5 Sec.) according to IEC 60076-part 5 – clause (4.1.5).
- ❖ The thickness of the radiator plates should be shock resistant and don't affect heat dissipation according to tender requirements.
- ❖ The noise level should be  $\leq 55$  dB at 0.3 meter distance according to IEC standards.
- ❖ The low voltage winding must be of copper foil for 250, 400, 630 & 1000KVA transformers.

- ❖ Off-load tap changer . . . . . five tapping for ( $\pm 2.5\%$ ,  $\pm 5\%$ ) on the H.T winding for off-circuit operation externally. The mechanical operation must be of the robust and definite position type with a click indicating position arrived during tap changing with suitable pad-lock.
- ❖ System Highest Voltage . . H.V side 12 kV
- ❖ Terminal arrangement of transformers:-
  - The 11 kV side terminal is to be a clamp type with eyebolt or flat bar type with nut suitable for conductors up to 150 mm<sup>2</sup> copper (for 100, 250, 400 KVA).
  - For 630, 1000 KVA the 11 kV side terminal is to be flat bar only.
  - The low voltage terminals are to be flat bar type with holes suitable for compression type thimble the sizes of L.V side:
    - ✓ For 100 KVA transformer 4x1x70 mm<sup>2</sup> copper (1 hole per phase).
    - ✓ For 250 KVA transformer 6x1x95+1x70 mm<sup>2</sup> copper (1 hole per phase).
    - ✓ For 400KVA transformer 7x1x150 mm<sup>2</sup> copper (2 holes per phase).

Terminal arrangement of outdoors transformers must be porcelain bushing insulator (brown colored preferable) mounted on the top cover of transformer for both H.T. and L.T, with arcing horn (double air gap is preferable) on H.T. bushing for outdoor transformer only. Neutral bushing should be distinguished from phase bushing.

- For 630 & 1000 kVA transformers should be either box-type or plug-in type for H.V. side (according to the tender requirements) with glands and cable holes suitable for cable size of 1 x 50 mm<sup>2</sup>, 12/20 kV.
- For L.V. side with glands and cable holes suitable for cable size of 1 x 240 mm<sup>2</sup>.

The cables arrangement as specified below:

- ✓ For 630 KVA transformer 11x1x240 mm<sup>2</sup> copper (4 holes per phase).
- ✓ For 1000 KVA transformer 14x1x240 mm<sup>2</sup> copper (4 holes per phase).

## **5- Fittings and Accessories:**

- Terminal marking plate.
- Tapping switch.
- Two valves (3/4 inches) diameter fitted on cover and bottom of tank, switch locks.
- Thermometer pocket with thermometer including max temp. measurement indicator with two separate free contacts.
- Lifting lugs.
- Pressure relief valve.
- Earthling terminal on tank.
- Rating and diagram plate to be chromium plated of the engraved type with kVA rating and serial number engraved on the cover of the transformer at a suitable place.
- Skid mounting to be vertical with the length of the transformer.
- Oil level indicator, to be of mechanical type located on the top cover of transformer to indicate the oil level with the temp variation, protected by metallic envelopes.

## **6- Painting**

- The painting should be oil and weather (dust, humidity and heat .... etc.) resistant type and the final coat is to be aluminum paint or equivalent. Any alternative finishing which gives better heat radiation is accepted and must be confirmed by calculations.
- Ministry of Electricity logo must be engraved on the cover of the transformer at a suitable place.

## **7- Insulating oil**

The transformer is to be shipped with first filling of oil which shall be (uninhibited insulation oil), according to the latest IEC 60296.



## **8 - Tender Price Evaluation (losses considerations)**

The following equation will be applied to calculate the cost of transformer, considering the age of the transformer, the iron losses and copper losses and the initial price of the transformer. This cost will be used for comparison the values of the tender and not the initial price of the transformer.

Ie = Iron (no-load) losses: 1800 USD per kW at rated voltage and frequency.

Cu = Copper (Load) losses: 600 USD per kW at rated power and principle tapping at 75°C

**Cost according to loss evaluation (for one transformer) = Initial price + (Guaranteed Ie x 1800 + Guaranteed Cu x 600)**

### **8-1 Loss evaluation**

The tolerance permitted is +10% of the evaluated guaranteed total losses mentioned in the offer. Any transformer with total losses more than + 10% will be rejected. For transformer with total losses within +5% of the evaluated guaranteed losses, no penalty shall be made. For transformers where the total losses between 105% to 110% of the total evaluated guaranteed losses , the contract price shall be reduced by the cost of the difference between the total losses and the 100% of the total evaluated guaranteed losses according to the following values.

Ie = Iron losses (kW).

Cu = Copper losses (kW).

Q = number of transformers required in the tender.

For any transformer with total losses less than 100% of the guaranteed losses , no variation to the contract price shall be made.

**Total penalty (USD) = Q x [(Measured Ie- Guaranteed Ie) Kw x 1800 USD/kW + (Measured Cu - Guaranteed Cu) kW x 600 USD/kW]**

## **9- Test**

### **9-1 Inspection:**

The transformer materials shall be inspected and tested by the owner inspectors or international inspector at any time during manufacturing.

The manufacturer shall provide all inspection facilities for the mentioned inspection and the inspection shall be made at the place of manufacture or at international testing facilities according to the tender requirements.

The inspector shall have the right of rejecting any portion of the material at any time during manufacture if it does not meet with the requirements of this specification in all particulars. He shall have the right of overseeing the packing and shipping of all material to be supplied.

### **9-2 Test at manufacture work:**

Test at manufacture's factory shall comprise type tests (if required according to the tender requirements) and routine tests according to the approved parameters in schedules A & B.

#### **a-Type tests**

The type test prescribed shall be carried out on one unit of each capacity

- 1- Test of temperature rise according to the latest IEC 60076.
- 2- Full - wave impulse-voltage withstand test according to the latest IEC 60076.
- 3- Cost of these tests to be borne by the manufacturer.

#### **b- Routine tests**

Each transformer shall be subjected to all the routine tests specified according to the latest IEC 60076.

#### **c- Special tests (if required according to the tender requirements).**

### **9-3 Test reports:**

Five copies of the test reports will be mailed within 8 days after the tests have taken place. These reports will indicate:

- The results of the tests.
- The calculation of performance of the items.
- The guarantee figures to show that each apparatus performs the conditions of the specification within the guaranteed values (schedules A & B).

### **9-4 Test Certificates:**

The tenderer shall furnish the Ministry of Electricity (MOE) with 6 copies of test certificates.

No equipment shall be shipped without obtaining the (MOE) inspector prior approval of the certificates.

### **9-5 Witnessing tests:**

Unless otherwise agreed to, all tests at factory shall be witnessed by an authorized representative from (MOE).

The cost of travelling & accommodation of the authorized inspectors to witness the test at the place of manufacture for required days, to be on tenderer account.

## **10- Drawing , Instruction Book And Litreature.**

### **10-1 document to be submitted with the tender:**

The following documents shall be submitted by the tenderer along with his offer:-

- a- Full technical specification of transformer including schedule A&B of guaranteed technical particulars.
- b- An outline drawing showing the plan , front and side elevation of the transformers , dimensions , terminals , equipment , and all accessories of the transformers.
- c- Catalogues of the manufacturer for transformers.
- d- Valid ISO-9001 certificate of the manufacture r for transformers.
- e- Test certificate for identical transformers.
- f- Reference list of manufactured and exported transformers.
- g- Incomplete offers are liable to rejection.

### **10-2 Document to be furnished by the successful tenderer:**

Within a period of 2 weeks from the commencement date, the successful tenderer shall furnish the following documents for final approval:-

- a- 24 sets (or according to the tender requirements) of prints on paper on all drawings.
- b- 24 copies (or according to the tender requirements) of all instruction books and technical maintenance of the transformer, OFF Load tap changing gear and other ancillary equipment.
- c- 24 copies (or according to the tender requirements) of instruction for erection of the equipment.
- d- 24 copies (or according to the tender requirements) of spare parts list with catalogue number.

### **10-3 Language:**

The language to be used in the drawings and instruction book shall be English.

#### **10-4 Dimensions:**

Due to the space requirement in our system it is important for the participants in this tender to make sure that the dimension of each type of the required transformers to be as small as possible the following table is indicative as a maximum for each single dimension:-

#### **Table of Dimensions**

Transformer (KVA)	Length (mm)	Width (mm)	Height (mm)
100	1220	600	1200
250	1230	700	1300
400	1400	1000	1400
630	1500	1200	1600
1000	1700	1400	1800

#### **10-5 Approval of drawings:**

The successful tenderer shall prepare and submit to the (MoE) all necessary drawings and specifications (schedule A & B) complete with explanations in due time and obtain approval of the same before commencing manufacture.

Failure to comply with this clause shall make the equipment or parts there of liable to rejection.

## **11- Packing**

The supplier will pack or protect the goods in the most appropriate manner.

He will be responsible for any loss or damage arising from careless packing or protection up to the place of final destination after completion of the inspection and tests at the factory, each item shall be packed for export shipment. All parts provided for shipping purposes only and which are to be removed at the time of erection shall be conspicuously tagged.

The method of packing shall be such as to protect all the items against excessive corrosion of dampness, and shall afford adequate protection against breakage or other injury, or loss due to breakage of cases or crates from the time leaves the factory until reaches the final destination, the apparatus will travel by rail by a long sea voyage again by rail or truck to the site of the substation. The equipment will also undoubtedly stand on wharves and in the open during and in between periods of transportation and will thereby be exposed to heavy rain, hot sun, humid climate and sudden changes of temperature.

Owing to the numerous handlings, the containers should be very strong also extra ordinary care should be given to the packing of the equipment and especially the items having insulating material to prevent the injury due to moisture, from sources external to the packing or from excessive condensation with the packing.

## **12- Spare parts and special tools for each rating**

### **12-1 Spare parts:**

1-	H.T / L.T winding.	3%
2-	H.T bushing with it's accessories.	10%
3-	L.T bushing with it's accessories.	10%
4-	Tap changer.	3%
5-	Pressure relief valve.	2%
6-	Oil level indicator.	10%
7-	Cover gasket	10%

**Note: Unit price per set and per piece for each item are required separately.**

### **12-2 Special tools:**

All special tools required for maintenance of transformer shall be included in the scope of supply. An itemized list of special tools together with prices shall be submitted with the tender.

**SCHEDULE ((A))**  
**SCHEDULE OF THE GUARANTEED PERFORMANCE AND**  
**OTHER TECHNICAL PARTICULARS**  
**(TO BE COMPLETED BY THE TENDERER)**

Unit	100	250	400	630	1000
	KVA	KVA	KVA	KVA	KVA
	Tr.	Tr.	Tr.	Tr.	Tr.

- 1- Name of manufacturer.
- 2- Country of origin.
- 3- Standard on which performance data is based.
- 4- Continuous maximum rating for the specified temperature rise and ambient temperature ONAN rating (KVA)
- 5- Rated temperature rise ( K )
  - a- Oil by thermometer.
  - b- Winding by resistance.
- 6- Hottest spot temperature rise (K).
- 7- No-load voltage ratio at normal tap & vector relationship.
- 8- Exciting current referred to H.V. and 50 Hz at ..... - (Amps)
  - a- 90% rated voltage.
  - b- 100% rated voltage.
  - c- 110% rated voltage.
- 9- Power factor of exciting current at 100% rated voltage and 50 Hz.....
- 10- Iron losses at 50 HZ ..... (kW).
  - a- 90% rated voltage.
  - b- 100% rated voltage.
  - c- 110% rated voltage.
- 11- Copper losses at full load (on rating) and at 75<sup>0</sup> C ..... (kW)
- 12- Total losses ..... (kW).
- 13- Resistance voltage at full load and 75<sup>0</sup> C ..... (%).
- 14- Reactance voltage at full load and 75<sup>0</sup> C ..... (%)
- 15- Impedance voltage at full load and 75<sup>0</sup> C ..... (%)
  - a- At normal tap.
  - b- At highest tap.
  - c- At lowest tap.
- 16- Resistance of H.V. winding per phase at 20<sup>0</sup> C ..... (ohms).
- 17- Resistance of L.V. winding per phase at 20<sup>0</sup> C..... (ohms).
- 18- Regulation at full load at 75<sup>0</sup> C ..... (%)
  - a- 1.0 power factor.
  - b- 0.8 P.F lagging.



- 19- Efficiency at 75° C ..... (%)
  - a- 100% load
  - b- 75% load
  - c- 50% load
  - d- 25% load
- 20- Calculated thermal time constant ..... (Hrs).
- 21- Maximum flux density at normal voltage and frequency and at normal ratio ..... (KI/sq.cm)
  - a- core
  - b- yoke
- 22- Maximum flux density at 110% voltage and frequency and at normal voltage and frequency and at normal ratio ..... (KI/sq.cm)
  - a- Core
  - b- Yoke
- 23- Insulation of
  - a- Core bolts
  - b- Core bolts washer
  - c- Side plates
  - d- Core laminations
- 24- Current density in windings – Amps/sq.cm.
  - a- H.V. winding
  - b- L.V. winding
- 25- Insulation on copper
- 26- Insulation strength of winding.
  - a- Impulse full wave .....(kV)
    - (I) H.V.
    - (II) L.V.
  - b- Impulse chopped wave .....(kV)
    - (I) H.V.
    - (II) L.V.
  - c- Applied voltage test ..... kV)
  - d- Induced voltage test ..... (kV)
- 27- Insulation strength of terminals.
  - a- Over voltage test .....(kV)
  - b- Minimum wet withstand voltage ..... (kV)
  - c- Minimum impulse withstand ..... (kV)
  - d- Minimum puncture or oil-immersed withstand voltage .....(kV)
- 28- Type of core
- 29- Tap changer
  - a- Manufacturer
  - b- Type

- c- Step of one tap in per cent of rated voltage
- 30- Thickness of transformer tank ..... (mm)
  - a- Sides
  - b- Bottom
  - c- Corrugated radiators
- 31- Weights and dimensions
  - a- Net weight of core ..... (Kg)
  - b- Net weight of copper ..... (Kg)
    - (i) H.V.
    - (ii) L.V.
  - c- Net untanking weight of
    - (i) Core ..... (Kg)
    - (ii) Frame .....(Kg)
    - (iii) Coil ..... (Kg)
  - d- Volume of insulating oil .....(liter)
  - e- Net weight of insulating oil ..... (Kg)
  - f- Total weight of transformer less oil .....(tons)
  - g- Weight of the largest shipping package ..... (tons)
  - h- Crane lift for untanking core and coils ..... (m)
  - i- Crane lift for removal of bushings ..... (m)
  - j- Dimensions of transformer ..... (m)
    - (i) Under base to top most point
    - (ii) Under base to bushing mounting flanges
    - (iii) Overall breadth
    - (iv) Overall length
  - k- Overall shipping dimensions of tee largest package.
- 32- Noise level ..... dB at 0.3 (m).

## SCHEDULE "B"

### OIL CHARACTERISTICS TABLE (TO BE COMPLETED BY THE TENDERER)

<u>NO.</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
<u>SPECIFICATIONS</u>		
1.	MAKER'S NAME	
2.	REFERENCE NAME OF OIL	
3.	SLUDGE VALUE	(Wt %)
4.	FLASH POINT (CLOSED)	°C
5.	POUR POINT	°C
6.	VISCOSITY AT:	
	a. 40° C	mm <sup>2</sup> /s
	b. -30° C	mm <sup>2</sup> /s
7.	ELECTRIC STRENGTH (BREAKDOWN	(KV)
8.	ACIDITY(NEUTRALIZATION VALUE)	
	a. TOTAL	mg KOH/g
	b. INORGANIC	mg KOH/g
9.	COPPER DISCELERATION	
10.	CRACKLE	
11.	SPECIFIC GRAVITY	
12.	SULFUR CONTENT	
13.	DIELECTRIC DISSIPATION FACTOR	(tan δ)