

**ELECTRICITY COMMISSION  
PLANNING AND STUDY DEPT.  
BAGHDAD, REPUBLIC OF IRAQ**

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| <b>SPECIFICATION No.</b> |
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| <b>D-26</b> |
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# **DISTRIBUTION TRANSFORMER**

## **0.416/11kV**

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| <b>REVISION</b> |
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| <b>YEAR 2001</b> |
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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 Sun 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 system | 12000 volts<br>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

phase,4-wire neutral solidly earthed.

Short circuit level

According to the short circuit level of H.T side and the rated power 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 net work 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 KVH.

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 °C in top oil by thermometer (ii) 50 °C in winding by resistance.

Off circuit tapings . . . . . five tapping for – 2.5% - 5% on the H.T winding for off circuit operation externally. The machine must be of the robust and definite position type with a click indicating position arrived during tap changing.

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 and nut suitable for conductors up to 150 mm<sup>2</sup> copper.

The low voltage terminal 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.

For 250 KVA transformer 6x1x195+1 70 mm<sup>2</sup> copper

For 400KVA transformer 7x1x150 mm<sup>2</sup> copper

For 630 KVA transformer 11x1x240 mm<sup>2</sup> copper

For 1000 KVA transformer 14x1x240 mm<sup>2</sup> copper

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

- For box-type transformer a suitable iron box cover the top bushings.

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

- Terminal marking plate.
- Tapping switch.
- Valves 3 / 4 B.S.P fitted on cover and bottom of tank, switch cocks.
- Thermometer pocket.
- Lifting lugs.
- Pressure relief valve.
- Earthling terminal on tank.
- Rating and diagram plate to be chromium plated of the engraved type.
- 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 avoid oil leakage , covered by metallic envelop.

## **6- painting**

A primary coat shall be applied immediately after cleaning all ungalvanized metallic parts thoroughly. An oil and weather resistant type second coat shall then be applied and the transformer finished in aluminum paint.

## **7- insulating oil**

The transformer is to be shipped with first filling of oil which shall be SHELL DIALA (B).

## **8- 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 variation to the contract price 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 105% of the total evaluated guaranteed losses according to the following values.

Iron losses 1800 USD per kW.

Copper losses 600 USD per kW.

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

## **9- Test**

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

The material shall be subjected to inspection and test by our inspectors or international inspector at any time during manufacture.

The manufacture shall provide all inspection facilities for the said inspection and inspection shall be made at the place of manufacture or at international testing facilities.

The inspector shall have the right of rejecting any portion of the material at any time during manufacture if it dose 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 work shall comprise type tests if required and routine tests.

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

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

- 1- Test of temperature rise – clause 41 of IEC 76/1967.
- 2- Full – wave impulse-voltage withstand test clause test  
45 of IEC 76/1967.
- 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 in section twelve of IEC 76/1967.

### **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 limits.

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

The tenderer shall furnish the Electricity Commission (EC) with 6 copies of test certificates.

No equipment shall be shipped without obtaining the (EC) 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 of our (EC).

The cost of travelling & accommodation of required authorized engineers 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 tender:-

- a- full and 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 tenders are liable to rejection.

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

Within a period of 4 months from the date of award of the contract , the successful tenderer shall furnish the (EC) with the following documents:-

- a- 24 sets of prints on paper on all drawings.
- b- 24 copies of all instruction books and technical maintenance of the transformer, OFF Load tap changing gear and other ancillary equipments.
- c- 24 copies of instruction for erection of the equipment.
- d- 24 copies 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 Dimension:**

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 Dimension**

| Transformer<br>KVA | Length<br>MM | Width<br>MM | Height<br>MM |
|--------------------|--------------|-------------|--------------|
| 100                | 1220         | 600         | 1200         |
| 250                | 1230         | 700         | 1300         |
| 400                | 1400         | 1000        | 1400         |
| 630                | 1500         | 1200        | 1600         |
| 1000               | 1500         | 1300        | 1800         |

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

The successful tenderer shall prepare and submit to the (EC) all necessary drawings 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 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 the items leaves the factory until finally installed at the substation during which time, 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% |

Unit price per set and per piece for each item are required.

### **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 ( valid clause 5 (1) ONAN rating-(KVA)
- 5- Rated temperature rise – ( C )
  - a- Oil by thermometer.
  - b- Winding by resistance
- 6- Hottest spot temperature-(c).
- 7- No-load voltage ratio at normal tap & vector relationship>
- 8- Exciting current referred to H.V. and 50 c/s and at . . – (Amps)
  - a- 90% rated voltage.
  - b- 100% rated voltage.
  - c- 110% rated voltage.
- 9- Power factor of exciting current at100% rated voltage and 50 HZ . . – (%).
- 10- Iron losses at 50 HZ and at .. – (kW).
  - a- 90% rated voltage.
  - b- 100% rated voltage.
  - c- 110% rated voltage.
- 11- Copper losses at full load (O.N.rating) and at 75 C – (kW)
- 12- Total losses ... .. – (kW).
- 13- Resistance voltage at full load and at 75 C ... (%)
- 14- Reactance voltage at full load and at 75 C ... (%)
- 15- Impedance voltage at full load 75 C ...
  - a- At normal tap.
  - b- At highest tap.
  - c- At lowest tap.
- 16- Resistance of H.V. winding per phase at 20 C... -(ohms).
- 17- Resistance of L.V. winding per phase at 20 C... -(ohms).
- 18- regulation at full load at 75 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... |         |
|    | 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.  |         |
|    | ( I I ) L.V.  |         |
| b- | Impulse chopped wave  | -(kV)   |
|    | ( I ) H.V.  |         |
|    | ( I I ) 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.

(i) L.V.

c-Net untanking weight of

(i) Core -(Kg)

(i) Frame -(Kg)

(ii) Coil -(Kg)

d- Volume of insulating oil -(IMP.Gall)

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

(i) Under base to bushing mounting flanges

(ii) Overall breadth

(i) Overall length

k- Overall shipping dimensions of tee largest package.

32- Noise level .....dB.

## SCHEDULE "B"

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

| NO. | DESCRIPTION                           | UNIT     | SPECIFICATIONS |
|-----|---------------------------------------|----------|----------------|
| 1.  | MAKER'S NAME                          |          |                |
| 2.  | REFERENCE NAME OF OIL                 |          |                |
| 3.  | SLUDGE VALUE                          | 0%       |                |
| 4.  | FLASH POINT (CLOSED)                  | °C       |                |
| 5.  | POUR POINT                            | °C       |                |
| 6.  | VISCOSITY AT 21                       | CST      |                |
| 7.  | ELECTRIC STRENGTH(BREAKDOWN           | KV       | VOLTAGE)       |
| 8.  | ACIDITY(NEUTRALIZATION VALUE)         |          |                |
|     | -TOTAL                                | mg/KOH/g |                |
|     | -INORGANIC                            |          |                |
| 9.  | SAPONIFICATION VALUE                  | mg/KOH/g |                |
| 10. | COPPER DISCELERATION                  |          |                |
| 11. | CRACKLE                               |          |                |
| 12. | SPECIFIC GRAVITY                      |          |                |
| 13. | SULFUR CONTENT                        |          |                |
| 14. | DIELECTRIC DISSIP ATION FACTOR (tend) |          |                |