

SPECIFICATION FOR 11 KV DISTRIBUTION TRANSFORMERS

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SPECIFICATION FOR 11 KV DISTRIBUTION TRANSFORMERS

1.0 GENERAL

This section of the Specification describes and specifies requirements for the supply, installation, testing, commissioning handing over in approved working order and maintenance during the Defects Liability Period of distribution transformers all in accordance with the Specification Supplementary Notes, Bill Of Qualities, Conditions Of Contract, Drawings etc.

2.0 STANDARDS AND APPROVAL

The transformers shall comply with the latest relevant British Standard Specifications, Malaysia Standard or IEC Recommendations and shall be of type approved by JKR.

3.0 TECHNICAL PARTICULARS AND GUARANTEES

Tenderers shall submit at the time of tendering detailed Technical Particulars and Guarantees in respect of the equipment offered which shall be binding. No departure from these Technical Particulars and Guarantees will be permitted except with the written approval of the S.O. Notwithstanding any description, drawings, illustrations or pamphlets which may be submitted with the Tender, all details other than those stated by the Tenderer in the Schedule of Departures from Specification at the time of tendering, will be deemed to be in full conformity with the Specification.

4.0 TRANSFORMERS

The transformers shall be suitable for continuous operation on a 3 phase, 50 Hz electrical power distribution system with neutral earthing conditions and maximum phase fault levels as follows :-

11 Kv

350 MVA

6.6 Kv	150 MVA
3.3 Kv	75 MVA
415 V	31 MVA

They shall be fully tropicalised and suitable for continuous operation at an ambient temperature up to 40 degree Celsius, relative humidity up to 100%, isoceraunic level up to 200 days per annum and altitude up to 1000 metres above sea level.

4.1 TYPE OF TRANSFORMER

The transformers shall be oil-immersed naturally cooled and hermetically sealed type complying with BS 171 or IEC 76 and suitable for indoor duties. Unless otherwise specified, they shall be low loss, step-down type of distribution transformers fitted with skid type bases.

5.0 ELECTRICAL REQUIREMENT AND PERFORMANCE

5.1 VOLTAGE RATIOS

The standard voltage ratios at no-load shall be as specified in the Bill Of Qualities and/or Drawings and shall in general be as follows :-

- (a) 11000/433-250 V, so as to deliver load at the declared voltage of 415/240 volts, 3 phase, 4 wire system with the neutral solidly earthed.
- (b) 11000/3300 V
- (c) 6600/433-250 V

5.2 WINDING CONNECTIONS AND VECTOR GROUP

Unless otherwise specified, the winding of all 3 phase step-down transformers shall be connected as follows :-

Higher Voltage	-	Delta
Lower Voltage	-	Star
Vector Group	-	Dyn 11

5.3 IMPULSE WITHSTAND VOLTAGE

Completed transformers arranged for service but with arcing horns removed shall be capable of withstanding the following negative polarity 1.2/50 microseconds impulse voltage on the higher voltage windings :-

Nominal System Voltage (Volt rms)	Impulse Withstand Voltage (Kv peak)
-----	-----
3300	45
6600	60
11000	75

All impulse shall be carried out in accordance with the provisions of BS 923 BS 171 or IEC 76.

Type test certificates may be accepted in lieu of separate impulse tests at the discretion of the S.O.

5.4 IMPEDANCE VOLTAGE

For the purpose of protection against short circuit stresses, the minimum value of impedance voltage at 75 degrees Celsius rated current shall be as follows :-

4.75%	for transformer up to 1000 KVA
5.5%	for transformer between 1000 - 1500 KVA
6.0%	for transformer between 1500 - 2000 KVA

5.5 FLUX DENSITY

The maximum flux density at any point in the magnetic circuit when the transformer is connected on the principal tapping and operating at normal voltage and frequency shall normally be in the region of 1.55 to 1.65 Tesla, but at the time of tendering alternative designs employing higher flux densities may be submitted. However with such higher flux densities for consideration the magnetic circuit shall not unduly saturate during system over voltage conditions.

5.6 LOSSES

The no-load and load losses shall be separately quoted in the Schedule of Particulars And Guarantees at the time of tendering. The losses shall be low commensurate with the economic use of materials such that the total capitalised cost is a minimum. The no-load and full load losses shall not exceed the values as follows :-

Size (KVA) -----	No Load Loss (Watt) -----	Full Load Loss (Watt) -----
100	220	1950
250	650	2100
315	700	3800
500	970	5400
800	1450	9500
1000	1650	10500
1250	1900	13000
1600	2450	17000

5.7 TAPPING RANGE AND METHOD

Tappings shall be provided on the higher voltage winding for a variation of the no-load voltage, as specified in clause 5.0 of + 5.0%, + 2.5%, 0%, - 2.5% and - 5.0%.

All tap changing shall be carried out with the transformers off circuit by means of an externally operated tapping switch with tap position indications. The operation handle shall be mounted on the tank side and provision shall be made for padlocking in any tap position. Padlocks of any approved type shall be supplied by the Electrical Contractor.

5.8 LIMITS OF TEMPERATURE RISE

The transformers shall be designed for continuous operation at their rated power without exceeding the temperature rise limits as follows :-

In Top Oil	:	50 degrees Celsius
In winding	:	55 degrees Celsius

5.9 CLASS OF WINDING INSULATION

The class of winding insulation shall be Class A to BS 2757.

5.10 NOISE AND VIBRATION

Due care shall be taken to ensure that the design and manufacture of all transformers shall be such as to reduce noise and vibration to a level normally obtained with good modern practice.

6.0 DESIGN AND CONSTRUCTION

6.1 CORE MATERIALS

All transformer cores shall be fabricated from high grade cold rolled grain oriented steel of low loss characteristics.

6.2 CORE CONSTRUCTION

All parts of the core shall be of robust design capable of withstanding mechanical shocks. Bracing of the core and winding assembly must be adequate to prevent any movement relative to the tank during normal lifting transportation and handling of the transformer.

The supporting framework of the core shall be design to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve, cause the trapping of air during filling or cause the trapping of gases which involve during in-service faults.

Individual laminations shall be insulated with material which will not deteriorate due to the action of pressure and hot oil.

6.3 WINDING CONDUCTOR MATERIAL

Winding shall be of copper conductors and shall be disposed

concentrically around the magnetic circuit limbs. Winding of aluminium conductors shall not be accepted.

6.4 WINDING CLAMPING AND BRACING

The winding and connection shall be adequately braced to withstand mechanical shocks and electromagnetic impulsive forces which may arise during handling, transportation and short circuit conditions.

6.5 WINDING INSULATION

Interturn insulation of winding, shall be of high grade paper. The insulation barriers between windings and to the core shall be cylinders of synthetic bonded paper, pressed board, fibreglass or equivalent, and shall be of high dielectric and mechanical strength.

6.6 OIL DUCTS

Oil ducts be provided where necessary to ensure adequate cooling. The coil clamping arrangement shall be such as will not impede the free circulation of oil through the ducts.

6.7 WINDING TAPPING

Tapping shall be located in such a manner to maintain the electrical balance of the windings and to reduce resulting axial forces to a minimum.

6.8 DRYING PROCESS

Before final assembly the windings shall be subjected to a drying process.

6.9 TRANSFORMER TANKS AND COVERS

The tanks shall be constructed from mild steel sheet having corrugated steel sides with strengthening bars to provide rigidity and mechanical strength.

The tank covers shall be welded on. The tanks and covers shall be so designed as to prevent collection of water on the outside surfaces.

The inside of tanks and covers shall preferably be sand or shot blasted or alternatively cleaned thoroughly by some approved means to remove all scales and rust, and shall be protected from rust by permanent coating not affected by hot oil.

Skid base shall be permanently welded. Lifting lugs shall be provided on the transformer so that the transformer complete with oil can be lifted.

6.10 COOLING SYSTEM

Cooling tubes or fins shall be fitted on the sides of the transformer. The arrangement of the tubes or fins shall be such that all painted surfaces can be readily cleaned and painted in position. The tubes or fins shall be designed to allow free circulation of oil and to prevent any accumulation of moisture.

6.11 CABLE BOXES

Cable boxes shall be provided at the high voltage terminals of the transformers. Unless otherwise specified in the bill of Quantities and / or Drawings, they shall be vertical bottom entry type.

On high voltage side, the bushing assembly shall be integral with the cable box.

On the low voltage side the bushing assembly shall be mounted on a plate which shall be flange mounted to a trunk or direct to the transformer side. The cable box shall be separated from the plate in order to facilitate conversion from normal bare bushing type to cable box type or vice versa.

The flange fixings on both high and low voltage sides shall be generally in accordance with BS 2562 Pt. 1 or other acceptable authoritative standards subject to the approval of the S.O.

Suitable wooden split clamps and galvanised iron channels shall be used to provide supports to the cables.

6.12 GASKETS

All gaskets shall be of synthetic rubber-bonded cork or other similar material subject to the approval of the S.O.

6.13 VALVES

All valves shall be attached to the transformer by machined flanges. The outlet shall have female threads. A male threaded plug incorporating a sampler shall be provided with each drain valve. Valves shall be closed by clockwise rotation of the handle and provision for padlocking in the closed and open positions shall be included.

6.14 FITTINGS

Unless otherwise stated in the Bill of Quantities transformers covered by this specification shall be provided with the following standard fittings :-

- (a) Terminal Marking and Rating Plates
- (b) Lifting Lugs
- (c) Jacking Lugs
- (d) Earthing Terminal (two numbers on opposite side)
- (e) Oil Level Indicator
- (f) Oil Temperature Indicator
- (g) Thermometer Pocket
- (h) Winding Temperature Indicator
- (i) Drain Valve
- (j) Filter Valve
- (k) Pressure/Vacuum Bleeding Device
- (l) Pressure/Vacuum Relief Device
- (m) Pressure/Vacuum Gauge

The transformers offered shall be suitable for installation within the room space as shown in Drawings, leaving adequate working space between the compartment walls and cable boxes and/or bushing terminals to facilitate the termination of H.V. and L.V. cables.

6.15 TERMINAL MARKING AND RATING PLATES

The terminal marking plate shall show a plan view of the terminals with the characters of terminal markings as per Appendix D of BS 171 or IEC 76 engraved thereon. It shall also show the tapplings in a tabulated form. The rating plate shall indicate the following :-

- (a) Manufacturer's name and address
- (b) Transformer Specification Reference
- (c) Manufacturer's Serial Number
- (d) Year Of Manufacture
- (e) Rating in KVA
- (f) Volts at no-load on normal tapping :-
 High Voltage
 Low Voltage
- (g) Current at rated load on normal tapping :-
 High Voltage
 Low Voltage
- (h) Number of phases
- (i) Frequency
- (j) Vector Group Symbol
- (k) % Impedance Voltage at Normal Tapping at 75 degrees Celsius
- (l) Mass of core and windings (untanking mass) (kg)
- (m) Mass of Oil (kg)
- (n) Total Mass (kg)
- (o) Quantity of Oil (litres)
- (p) Maximum Temperature Rise in Oil (degree Celsius)
- (q) Tapplings in Tabulated form

The terminal marking and rating plates shall be of a durable and corrosion resisting material and the markings thereon shall be permanently legible. The two plates may be combined into a single plate.

6.16 CLEANING AND PAINTING

No painting shall be carried out on the transformers until they have been tested and found satisfactory. All exterior ungalvanised

surfaces of tanks and covers shall be thoroughly cleaned of all scales and rust preferably by shot blasting. Following which a priming coat of red lead or other approved paint shall be applied over all metal surfaces liable to rust. After completion of the Works Tests, two further coats of Oil and weather resisting paint shall be applied. The first coat being allowed to dry and thoroughly set before the second is applied.

6.17 OIL

Transformers shall be supplied filled with oil and hermetically sealed. The oil shall meet the requirements of BS 148 and shall be completely free from PCB.

7.0 TYPE TESTS AND ROUTINE TESTS

Each transformer and ancillary equipment shall be inspected and tested during manufacture and before despatch to site. Tests shall include type tests as specified in BS 171 or IEC 76. viz.

(a) Type Tests

- (i) Full wave impulse voltage withstand test**
- (ii) Temperature rise test**
- (iii) Short circuit test**
- (iv) Measurement of zero sequence impedance**
- (v) Transformer tank vacuum test**
- (vi) Transformer tank pressure test**

(b) Routine Tests

- (i) Measurement of winding resistance**
- (ii) Measurement of voltage ratio and check of voltage vector relationship**

- (iii) Measurement of impedance voltage and short circuit impedance
- (iv) Measurement of load loss
- (v) Measurement of no load loss
- (vi) Separate source power frequency voltage withstand test
- (vii) Induced overvoltage withstand test
- (viii) Transformer noise level measurement

8.0 PACKING

Transformers shall be shipped with the core and windings fully immersed in oil and hermetically sealed after the transformer has been dried out in an approved manner.

All plant and equipment shall be packed in a manner so that they are protected adequately against the tropical climatic conditions encountered during shipment and storage at site. All fragile parts shall be packed separately in an approved manner. Pipe ends and flanged openings shall be protected against external damage as well as against ingress of dirt and moisture during transit and storage at site.

9.0 EARTHING

The neutral point of the low voltage system of the transformer shall be solidly earthed to achieve an earth resistance not exceeding one ohm. The frameworks and all non-current carrying metal parts of the transformer shall be earthed similarly to achieve an earth resistance not exceeding one ohm. An earth bar of flat hard drawn copper with dimension not less than 25 mm x 6mm shall be installed around the four walls of the transformer room at a height of 300 mm from the finished floor level. The earth bar shall be bolted to the frame earth of the transformer. All joints of the earth bar shall be tinned and bolted. The earth bars shall be painted with an approved green enamel.

Unless otherwise specified, the neutral earth and the frame earth of the transformer shall be separately connected to its own group of earth electrodes. The neutral earth and the frame earth shall be connected to its electrodes by means of two numbers green PVC insulated copper cable of cross

sectional area not less than 70 sq.mm. The two groups of earth electrodes after having been hang verifies by the S.O. to be each of earth resistance not exceeding one ohm, shall be linked together by means of PVC cables as mentioned above unless otherwise specified. At least two points of the frame earth system of the transformer shall be connected to the earth electrodes.

Earth electrodes shall be of copper jacketed steel core rods with 16 mm diameter and supplied in 2.4 m length and shall have provision for screw coupling with another standard length. The copper jacket shall be of minimum thickness 0.25 mm and shall be metallically bonded to the steel core to ensure that the copper jacket and steel core are not separable. Where the desired earth resistance value cannot be driven, sufficient number of sets of earth electrodes shall be installed outside the resistance area and linked together by PVC copper cables as mentioned above until the required value is reached. Each set of earth electrode shall be provided with brass connecting clamp and approved type of precast heavy duty concrete inspection chamber with removable cover.

The earthing points shall be identified by permanent label legibly marked with the words 'Transformer Frame Earth' or 'Transformer Neutral Earth' permanently fixed at the point of connection of every earthing conductor to an earth electrode.

11.0 INSPECTION, TESTING AND COMMISSIONING

11.1 INSPECTION AND ACCEPTANCE TESTS

The whole of the plant and equipment to be supplied under the Tender shall be subjected to inspection and acceptance tests by the S.O. and his officers in the factory prior to delivery. The approval by the S.O. of the results of any such inspection or test shall not prejudice the right of the S.O. to reject the plant if it fails to comply with the specification when erected or to give complete satisfaction in service within the Defect Liability Period. The price quoted in the Bills Of Quantities for the inspection and acceptance test as stated above shall include the provision of all necessary equipment, facilities, expenses, allowances etc for the S.O. and his officers to inspect the plant and equipment and to verify the tests. Adequate notice shall be given when the plant is ready for inspection and acceptance test.

11.2 SITE TESTING

On completion of the installation work on site the Electrical Contractor shall at his own expense arrange for all necessary tests to be carried out on the equipment by either TNB or a Services Engineer approved by the Jabatan Bekalan Elektrik as part of the tests required of him for the whole installation under this Contract. The test to be carried out shall be as prescribed in the relevant British Standard Code Of Practice for high voltage transformer the IEE Wiring Regulations 15th Edition, the Electricity (Board Supplies) Rules 1949 and other tests deemed necessary by the S.O. In the event the installation fails to pass any of these tests the Electrical Contractor shall take such measures as are necessary to remedy the defects and the installation shall not be considered as completed until all such tests have been passed. The tests to be carried out by the Electrical Contractor shall consist of the following tests as the minimum requirement :-

- (a) 2000 V insulation resistance tests
- (b) 24 Kv a.c. pressure test for 1.0 minute.
- (c) Testing and setting of safety devices and measuring gauges.
- (d) Any other tests as recommended by the manufacturer and the supplier.

The S.O. reserves the right to be present at all tests and the Electrical Contractor shall give at least one week notice in writing to the S.O. for this purpose. In any case no test shall be carried out without prior approval of the S.O. Copies of all the test certificates shall be submitted to the S.O. within one week after the completion of the testing.

11.3 COMMISSIONING

On successful testing of the complete installation the Electrical Contractor shall arrange to commission the equipment in the presence of the S.O. on a date to be decided by the S.O.

12.0 REJECTION OF PLANT

Any item of plant or component which fails to comply with the requirements of this specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site within the Defects Liability Period of the Contract may be rejected by the S.O. either in whole or in part as he considers necessary. After adjustment or modification if so directed by the S.O. the Electrical Contractor shall submit the item for further inspection and or tests. Plant for component with defects of such nature that, in the opinion of the S.O. the requirements of this specification cannot be fulfilled by adjustment or modification shall be replaced by the Electrical Contractor at his own expense and to the satisfaction of the S.O.

13.0 OTHER ITEMS TO BE SUBMITTED WITH THE TENDER

13.1 MANUFACTURER'S CATALOGUES AND DRAWINGS

Manufacturer's catalogues and drawings giving detailed information on the general arrangement of the transformer overall dimensions, weight, general construction, positions of cables, grouting bolts, loading on foundation, minimum clearance to walls, trenching details, technical specification and other useful details shall be submitted together with the Tender.

13.2 RECOMMENDED SPARES

The tenderer shall submit with his Tender separate Schedule of Spares recommended by the supplier of the equipment. This Schedule shall contain the price and delivery period of each items of the spares recommended. The Tenderer shall also recommend the quantity of each item to be stored for the purpose of maintenance. The prices of these spares shall not be included in the total Tender Price and the purchase of all or any of the spares listed shall be at the option of the S.O. The prices quoted shall be valid for acceptance during the Contract Period (extended

if applicable) of the project.

All spare parts shall be original and fully interchangeable with the corresponding part used in the main items of the equipment and with each other without having to resort to machining or additional, fittings at site. All spares shall be finished, protected, packed and labelled in suitable manner to prevent deterioration during prolonged storage in tropical climate.

14.0 WORKING DRAWINGS, INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTION

14.1 WORKING DRAWINGS

Within two weeks after award of the Tender or such shorter period as may be required by the S.O., the Electrical Contractor shall submit to the S.O. for his approval four sets of the details of the layout of the transformer in the transformer room provided. The drawings submitted are to be modified if necessary a requested by the S.O. and resubmitted for final approval. It is to be understood however, that approval of the drawing will not exonerate the Electrical Contractor from any responsibility in connection with the work.

14.2 INSTALLATION OPERATION AND MAINTENANCE INSTRUCTION

As soon as the general arrangement and details of the equipment to be supplied have been finalised and before the delivery of the equipment, the Electrical Contractor shall submit to the S.O. two copies of detailed installation, operation and maintenance instructions in respect of the equipment to be supplied. The instructions shall cover the main as well as any associated equipment. For this purpose manufacturer's standard brochures will be acceptable provided that they refer particularly to the equipment to be supplied and are free from extraneous matter.

The instruction shall include essential details, drawings and sketches of the equipment installation, operation and maintenance techniques and make mention of special materials where used and include schedules of recommended lubricants etc. Each of the above two sets of manuals submitted shall be in a stiff cover ring file and with titles to the satisfaction of the S.O. The cost of these manuals shall be deemed to be included in the Tender Price.

15.0 TRANSFORMER ROOM

Approved type of rubber mat shall be provided around the transformers. The rubber mat shall extend to the full length and width of the transformer and shall be of thickness not less than 5 mm and width 1000 mm.

'BAHAYA' sign, 'DILARANG MASUK' sign, sign indicating 'Substation No : ' and shock treatment chart shall be installed to the requirement of the Jabatan Bekalan Elektrik and to the satisfaction of the S.O. ' DILARANG MEROKOK ' sign shall also be installed.

All trenches in the transformer rooms shall be filled up with clean sand to a level above cable ducts.

As fitted layout plans, schematic wiring diagrams, and plans showing cable routes and positions of earthing point with reference to easily recognisable buildings and structures shall be suitably framed up in the transformer room. These plans and diagrams shall be in addition to the four sets of prints required to be submitted to the S.O. after completion of the project as stated in clause 17.0 below.

One 9 kg. dry powder fire extinguisher for A/B/C class of fire and complete with discharge hose, nozzle and wall bracket shall be supplied and installed in every transformer room.

16.0 SERVICE AND MAINTENANCE

During the Defects Liability Period the Electrical Contractor shall be responsible for the service and maintenance work for the complete installation. All works shall be carried out by competent personnel. All labour material, tools and parts necessary to rectify the defects due to manufacturing/installation faults shall be supplied/executed at the Electrical Contractor's cost.

The service and maintenance to be performed shall include but not be limited to the following :-

- (a) Replacing or making good all components of the transformer and ancillary equipment etc.
- (b) Replacing and making good all loose and burnt cables and terminations, all mechanical support and linkage, earth electrodes, earth electrode chambers and covers, conduits trunkings etc.
- (c) Making good any damage to roads, buildings, drains cables, pipes, concrete areas, paved areas etc. which had not been properly made good arising out of his work.
- (d) All other works as deemed necessary by the S.O.

All works shall be carried out as soon as the Electrical Contractor has been informed by the S.O. or the occupant and shall be completed within a reasonable time except under Additional General Conditions. If the Electrical Contractor fails to comply with the above requirement, the S.O. reserves the right to engage another party to carry out the works, in which case the Electrical Contractor shall be responsible for all the expenses incurred.

17.0 AS INSTALLED DRAWINGS MANUALS AND TOOLS

The drawings, manuals, tools etc. as mentioned below shall be provided whether or not they are separately itemised in the Bill Of Qualities of the Tender Document. The cost of all these drawings, manuals, tools, etc. is deemed to be included in the Tender Price.

17.1 AS INSTALLED DRAWINGS

Within three calendar months after the practical completion of the

project, one set true to scale negatives (110/115 gm/sq.m ISO A0 or A1 size) and four sets of prints for each of the following drawings shall be submitted.

- (a) Site Plan.
- (b) Schematic Wiring Diagrams and Electrical Layout Plans.
- (c) Layout Plans of cable routes and earthing points with reference to easily recognisable buildings and structures.

These drawings shall be properly stencilled and shall have at the lower right hand corner the Electrical Contractor's name and address, date of commissioning, scale, drawing number (the drawing number to be obtained from the S.O., title and the following particulars :-

JABATAN KERJA RAYA
CAWANGAN ELEKTRIK
CONTRACT NO.
TENDER NO.

If the drawings submitted are not acceptable by the S.O. the Electrical Contractor shall amend and resubmit the drawings within two weeks from the date of return of the drawings.

17.2 MANUALS

Four sets of the following manuals and documents of the transformers and ancillary equipment shall be supplied :-

- (a) Installation Manual.
- (b) Operation Manual.
- (c) Service And Maintenance Manual.
- (d) Parts List
- (e) Product Data and Catalogues
- (f) Test Certificates

The installation, operation, service and maintenance manuals shall be the same as those described in clause 17.1 and the manuals, parts list, etc. described above shall be in a stiff cover ring file.

17.3 TOOLS

One set of standard tools and any special tools, gauges, handling appliances etc. as recommended by the manufacturer for the assembly, operation, checking, adjustment and normal maintenance of the transformers and the ancillary equipment shall also be provided for each substation.

18.0

SCHEDULE OF PARTICULARS & GUARANTEES

(To be filled in by the tenderer)

ITEM	DESCRIPTION			
1.	General			
(a)	Name of Manufacturer			
(b)	Name of Supplier			
(c)	Model/Type Reference No.			
2.	Capacity of Transformer	KVA	KVA	KVA

3.	Rated Power	KVA			
4.	Number of phases				
5.	Frequency	Hz			
6.	No-load transformation ratio				
7.	Winding connections				
8.	Maximum temperature rise				
a)	Windings, by resistance	degree C			
b)	Top Oil by thermometer	degree C			
9.	Maximum flux density at normal volts, frequency and ratio	Tesla			
10.	Maximum current density at rated load				
a)	High voltage	A/sq.mm			
b)	Low voltage	A/sq.mm			
11.	Losses				
a)	No-load loss at rated voltage frequency and normal tap	KW			
b)	Load loss at rated current and normal tap at 75 degree C	KW			

12.	Efficiencies at :-			
a)	Full load unity power factor %			
b)	Full load 0.8 power factor %			
c)	3/4 load unity power factor %			
d)	3/4 load 0.8 power factor %			
e)	1/2 load unity power factor %			
f)	1/2 load 0.8 power factor %			
13.	Impedance volts at normal ratio and rated KVA at 75 degree C			
14.	Voltage drop between no-load and full load at 75 degree C :-			
a)	At unity power factor %			
b)	At 0.8 power factor %			
15.	Impulse withstand voltage :-			
a)	H.V. Windings Kvp			
b)	L.V. Windings Kvp			
16.	Type of windings :-			
a)	H.V. Windings			
b)	L.V. Windings			
17.	Insulation materials :-			
a)	H.V. Windings			
b)	L.V. Windings			
19.	Core bolts and plates			
20.	Core laminations			
21.	Clearances :-			
a)	Phase to Phase in Oil minimum mm			
b)	Phase to Phase out of Oil minimum mm			
c)	H.V. to tank in oil minimum mm			

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b)	Thickness of bottom	mm			
c)	Thickness of plate	mm			
d)	Thickness of cooling fins	mm			
23.	Total volume of oil	litres			
a)	Total mass of completed transformers with oil and all fittings.	kg			
b)	Mass of transformer arranged for transport	kg			
24.	Overall Dimensions :-				
a)	For service	mm			
b)	For transport	mm			
25.	Type of gasket				

26.	Schedule of Departure from Specification :-			
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* Tenderer shall enter details at the time of tendering. If no details are entered, the transformers shall be deemed to be fully complied with the requirements of this Specification.

Signature :.....

Name of Tenderer:.....

.....

Chop of Tenderer:.....

.....

.....

Date :.....

19.0

SCHEDULE OF SPARES

Item	Type Of Spares	Delivery Period	Quantities Recommended	Unit Price	Total
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
				Total	

The price quoted shall valid for acceptance during the Contract Period (extended if applicable) of the project.

Signature :

Name of Tenderer:

Chop of Tenderer:

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Date

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