



Lot # (1)

**Supply of Power Transformers and 220/66/22 KV
Electrical Equipment.& Switchgear**

Annex VI

TECHNICAL SPECIFIATIONS

1. GENERAL SPECIFICATIONS

1.1 Completeness of Contract

1.1.1 All apparatus, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of the finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall be complete in all details, whether or not such details are mentioned in the Specifications. This includes fixation details and connection clamps and/or terminals.

1.1.3 Any reference in the quantity and price schedules, the delivery period schedule or in the various clauses and schedules of the text of either the Specification or the Bid, to any equipment shall imply that the equipment is complete with all accessories, apparatus and fittings as outlined in sub-clause 1.1.1 above.

1.1.4 The Bidder shall be responsible for ensuring that the equipment supplied is fit for the purpose intended. Available information on the characteristics of the system to which the works will be connected and associated will be supplied on request to the Bidder who shall be responsible for obtaining and determining all applicable knowledge relevant to the works.

1.2 Drawings and Documentation

The Contractor shall prepare and submit to the supervision team for approval dimensioned general and detailed design drawings and other pertinent information of all the Equipment and Materials specified in the Specifications.

The Contractor shall supply detailed instructions for erection, operation and maintenance of all equipment and components in English and preferably Arabic language. In the event of any difference between the drawings and the Specifications, the latter shall prevail.

Approval of drawings shall not relieve the Contractor of his obligations to supply the Plant in accordance with the Specifications. In the event of any difference between scaled dimensions and figures on the drawings, the figures shall prevail.

All text on drawings provided by the Contractor shall be in the English language in addition, if necessary, to that of the country of origin.

All drawings shall be dimensioned in millimeters.

1.3 Time of Delivery and Completion

The guaranteed delivery times shall be stated in the appropriate schedule in this document.

1.4 Quality of Materials

All materials supplied under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the

variations of temperature and atmospheric conditions arising under working conditions without distortion or deterioration in the setting up of undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed. No toxic material (such as Halon, PCB, and Asbestos) shall be utilized.

1.5 Contractor's Quality Assurance Procedures

The Bidder shall have established a quality assurance system based on ISO 9001 or 9002. The Contractor shall include a documentation of the system with a list of current procedures, an organigram of the quality organization and the name of the quality manager. He shall also submit a list of quality revisions performed the last twelve months with a list of closed and unclosed findings as well planned revisions the coming twelve months.

The Contractor shall submit for approval a program of quality control and inspection procedures to assure that the product during manufacture and on completion complies with the specified requirements. The program shall relate the quality control and inspection activities to the production cycle. In support of the quality control and inspection program the Contractor shall provide details of quality control and inspection procedures available for use in the execution of the Contract. The Contractor shall retain responsibility for quality control and inspection activities made by his sub-contractors and shall indicate on the program, which items are to be sub-contracted.

1.6 Guarantees and Particulars

The Works shall comply with the technical guarantee data stated in the Bid. The Contractor shall be responsible for any discrepancies, errors and omissions in the particulars and guarantees, whether the supervision team have approved such particulars and guarantees or not.

1.7 Places of Manufacture and Sub-Contractors

The manufacturer's identity and places of manufacture, testing and inspection before shipment for the various portions of the Contract Works shall be specified in the Technical Schedules and shall not be departed from without the agreement of the supervision team

All Sub-contractors and Sub-suppliers of components and materials shall be subject to the approval of the supervision team. Information shall be given on each Sub-order sufficient to identify the material or equipment, to which the sub-order relates, stating that the material is subject to inspection by the supervision team before dispatch.

All equipment offered shall be the product of recognized and experienced manufacturers and shall be proven equipment of the same basic design and size similar to that which has been in successful continuous operation for at least three years preferably under similar climatic conditions. Proven plant reliability and high availability are of prime importance and the attention of the Bidder is drawn to these particular requirements.

1.8 Inspection and Testing

All materials used in the Contract Works may be to inspection by the supervision team and it is the Contractor's responsibility to advise the supervision team when equipment and materials are available for inspection, at least 1 month in advance.

Factory tests on equipment shall be made according to the applicable IEC Standards, or as specifically specified or according to standards approved by the supervision team.

Routine tests shall be made on each unit of all equipment.

Type tests shall be made on one unit of each type of different equipment. Instead of carrying out the type tests the Contractor may submit suitable certificates of tests made on equipment of the same type; however, the Employer reserves the right of accepting these certificates or to reject them partially or totally.

The supervision team shall be at liberty to demand any additional testing at the manufacturer's works, at site or elsewhere in order to verify that the equipment complies with the conditions of the Specifications.

A test program shall be submitted to the supervision team for approval at least 1 month ahead of the commencement of testing.

Measuring apparatus shall be approved by the supervision team and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

1.9 Packing, Transportation and Storage

Packing shall give adequate protection to the enclosed materials against mechanical damage during transport to its final destination, including rough handling during sea, rail and road transport and transition from one mode of transport to another.

Packing should be stout close-boarded wooden cases of adequate thickness, suitably braced and banded and lined internally with water-resistant material or equally solid enclosures.

Steelworks sections and similar items may be bundled provided that the ends are adequately protected and the enclosing bands or wires are robust.

Indoor electrical equipment must be enclosed in welded polythene envelopes inside packing cases and the envelopes shall be evacuated or have a desiccant inside.

All items in cases or crates shall be secured so that they are not free to move and cannot work loose in transport. If rotating parts are shipped within their bearings or mountings, they must be adequately braced and restrained to prevent relative movement. Loose items shall be placed in bags in a case, each bag having stitched onto it a label indicating the number and nature of its contents. Where a filler material is used in a case to restrict movement or provide additional protection, it must be inorganic and non-hygroscopic.

All surfaces liable to corrosion shall be thoroughly cleaned and special steps adapted to the nature of the materials and the time interval between packing and unpacking shall be taken to prevent corrosion. These steps may constitute the greasing on surfaces, the application of a protective coat, enclosure of the items in a hermetically sealed container, the addition of vapor phase inhibitor paper to the package or other approved means.

Steps shall be taken to ensure that moisture, moulds, insects or rodents cannot damage insulated materials. Items that include materials liable to be damaged by moisture shall be packed in hermetically sealed containers in which silica gel, or some other approved

desiccant has been inserted.

Cases shall be marked with large lettering to show which side of the case is to be up, and if the contents are fragile, marked "FRAGILE" in large letters with the international wineglass symbol. Packages shall be marked with their place of destination in such a way that rough handling or the effect of weather cannot remove or obliterate the marking. Each item shall be marked with its gross weight and, for all lifts over two tonnes, marks on the cases shall show the correct positions for the slings.

Special steps shall be taken to guard against theft during transport. No small items such as padlocks nameplates and so forth that could be torn off or unscrewed shall be accessible.

Cases, crates, barrels and drums shall be banded in such a manner as to obstruct the theft of any of the timber used for packaging and the bands shall be so secured that they are not rendered ineffective by shrinkage of the wood.

A descriptive and fully itemized list shall be prepared of the contents of each packing case. A copy of this list shall be placed in a waterproof envelope under a metal or other suitable plate securely fastened to the outside of one end of the case, and its position indicated by stenciling on the case. Where appropriate, drawings showing the erection markings of the items concerned shall be placed inside the case.

All stenciled markings on cases and crates, or other markings on descriptive metal tabs fixed to cable drums, bundles of structural steelworks and so forth, shall be applied in two places with a material which cannot wash off and shall be additional to any erection or other marks or impressions which may be specified elsewhere.

Shipping marks are to be stenciled in oil based paint in block letters and symbols. When unobstructed flat smooth surfaces of sufficient size are not available on the case for the shipping marks they are to be stencilled on marine-ply notice boards of adequate size and of at least 6 mm thickness securely fastened to the packing case.

All packing cases, though not steel containers, shall remain the property of the Employer.

1.10 Tools

The Supplier shall supply in lockable boxes, for the Employer's use, any special tools that may be required for assembly, dismantling and adjustments to the equipment. The tools shall be unused and in new condition at the time of hand over. Suitable special spanners shall be provided for bolts and nuts which are not properly accessible by means of an ordinary spanner.

2 .GENERAL TECHNICAL SPECIFICATION

2.1 General

This Chapter contains a general technical specification of electrical equipments and may cover equipment not to be procured under this contract. For details about each type of equipment to be procured reference is made to Section 3-Particular Technical Specifications.

The design shall incorporate every reasonable precaution and provision for the safety of the general public as well as for all those engaged in the operation and maintenance of the Contract Equipment and of associated works supplied under other Contracts.

2.2 Drawings

The Bidder shall in his Bid enclose overall drawings showing dimensions, main working principles, internal components and fixing methods to a detail level allowing the Employer to evaluate the functionality and completeness of the equipment.

2.3 Standards

Ratings, characteristics, tests and test procedures, etc. for the electrical equipment encompassed by this specification shall comply with the relevant provisions and requirements of the Recommendations of the International Electro technical Commission (IEC), unless otherwise expressly stated in Particular Technical Specifications. This applies even where the specific standards are not referred to in the Particular Specifications. Where the IEC Recommendations do not fully cover all provisions and requirements for the design, construction, testing, etc. and for equipment and components that are not covered by IEC Recommendations, recognised national standards shall be applied. The rules of CEE (International Commission for the approval of electrical equipment) and the standards of CENELEC (Comite Europeen de Normalization Electrotechnique) may also be applied.

The latest revision or edition in effect at the time of Bid Invitation shall apply. Where references are given to numbers in the old numbering system from IEC it shall be taken as to be the equivalent number in the new five digit number series.

The Precise Standard, complete with identification number, to which the various equipment and materials are manufactured shall be specifically stated by the Bidder.

In case of conflict or disagreement between the particulars of the Standard adopted by the Bidder and the particulars of this Specification, this Specification shall prevail over the Standard. All conflicts or disagreements, mentioned above, must be clearly stated, failing which the materials and equipment offered shall be deemed to comply in every respect with this Specification both in manufacture and in performance, and compliance thereof be insisted upon without additional cost to the Employer.

2.4 Units

The SI-system (meter, Newton, second) shall be used throughout the works covered by this Specification.

2.5 Definitions

Whenever the following terms or words are found in the specifications and/or other documents, they shall have the following meaning:

"HighVoltageEquipment"(HV):

Mostly used for equipment provided for a maximum operating voltage higher than 36 kV (generically also used for voltages down to 1000 V).

"MediumVoltageEquipment"(MV):

Equipment provided for a maximum operating voltage higher than 1000 V and up to 36 kV.

"LowVoltageEquipment"(LV):

Equipment provided for operation at 1000 V or below. (For transformers the term Low Voltage Winding is used for the side with lowest rated voltage regardless of value, . IEC 60076)

Reference to degree of protection (IP) is according to the classification in IEC 60529

2.6 System Characteristics

The basic characteristics of the electrical systems and equipment shall be as follows (not all voltages are applicable to this contract):

MVEquipment33kV

Maximum operating voltage 36 kV, 3-phase, 50 Hz, delta connected system with neutral solidly earthed via zigzag-star connected earthing transformer.

MVEquipment22kV

Maximum operating voltage 24 kV, 3-phase, 50 Hz, star connected system with neutral solidly earthed via earthing resistor

MVEquipment11kV(alsotobeusedfor6.6kVnet)

Maximum operating voltage 12 kV, 3-phase, 50 Hz, isolated delta.

MVEquipment6.6kV

Maximum operating voltage 7.2 kV, 3 phase 50 Hz, neutral solidly earthed.

LVEquipment,0.4kV

Maximum operating voltage 420 V, 3-phase, 50 Hz, loaded and effectively earthed neutral TN-S system.

2.7 Phase Relationship

The standard phase colors are Red (L1), Yellow (L2), Blue (L3) (RYB).

2.8 Design Criteria

The equipment shall be designed to withstand the design stresses given below without damage and disruption of service. All tests shall as a minimum is based on these design parameters.

Item	Description	Unit	Nominal voltage level				
			33	22	11	6.6	0.4
1	Nominal system voltage phase to phase	kV	33	22	11	6.6	0.4
2	Highest system voltage phase - phase ¹⁾	kV	36	24	12	7.2	0.42
3	System Frequency	Hz	50	50	50	50	50
4	System earth(see above)	----	Solid	solid	Solid	Solid	Solid
5	Minimum Design Short circuit Current (1 sec. arch test) ²⁾	kA	31.5	25	25	25	25
6	Impulse withstand voltage (1.2/50 μ sec wave) ³⁾	kV peak	170	125	75	75	-
7	Power frequency withstand voltage (1 min.) ³⁾	kV	70	50	28	28	2.5
8	Min creepage distance over outdoor insulators (Pollution class 3- severe, IEC 60815/85 - 2.5cm/kV)	cm	90	60	31	31	-

Note1)

Ref. IEC 60038

Note2)

For all current carrying parts the permissible short circuit duration shall be at least 1 second. Indoor equipment shall be arc tested in accordance with IEC

60298 amendment 2. The dynamic or momentary short circuit current on which the equipment design shall be based shall be computed by multiplying the r.m.s. value of the symmetrical short circuit current by the factor $1.8 \times \sqrt{2}$

Note3)

Ref. IEC 60071

2.9 Ambient Temperatures, Relative Humidity, Wind Pressure

Unless otherwise specifically stated in Particular Technical Specification, any equipment, component and assembly shall be designed for the following service conditions:

Description	Unit	Value
1 Altitude of site above sea level	m	- 400 to + 900
2 Ambient Temps:- Maximum Minimum	°C °C	45 - 5
3 Wind Speed	m/s	15
4 Isokeraunic Level		15
5 Pollution Type		Dust
6 Relative Humidity Maximum Minimum	% %	100 <10
7 Rainfall Average annual	mm	600
8 Hail		Yes
9 Fog		Yes
10 Sand Storms		Occasional

Wherever any of these maximum or 24 hour average temperatures exceed the normal service condition temperatures of the IEC Recommendations for the relevant equipment, or of such other standard which is approved to be applied, the permissible temperature rises of the recommendations or the standard shall be reduced by the same amount as the difference between the above figures and the normal service condition temperatures.

The Contractor shall guarantee these reduced temperature rises.

2.10 Power Cables

The following assumed values of soil thermal resistivity, soil and air temperatures are for Tender evaluation purposes only.

Maximum ground temperature	°C	30
Soil thermal resistivity	°C m/W	1.8
Max. ambient shade temperature	°C	30-40

The underground cables shall be designed to withstand a short circuit current of 30 kA for 1 sec.

2.11 TECHNICAL DATA SCHEDULES

2.11.1 PREAMBLE

1.1 All the Technical Schedules shall be filled in and completed by the Tenderer, and submitted with the Tender.

1.2 All documentation necessary to evaluate whether the equipment offered is in accordance with this Specification shall be submitted with the Tender.

1.3 All data entered in the Schedules of Technical Data are to be regarded as values guaranteed by the Tenderer and shall not be deviated from unless approval to do so is obtained from the Engineer.

1.4 All data entered in the Schedules of Informative Data are also to be regarded as values guaranteed by the Tenderer. These data may only be deviated from if approval to do so is obtained from the Engineer.

1.5 Necessary copies of the schedules format shall be used if necessary to provide space to submit data on all the equipment offered.

1.6 Equipment or Systems offered which are not in accordance with the Specification shall be listed and described in Schedule 'B' - Deviations from Specifications. If there are no deviations, this shall also be stated in Schedule 'B'

2.11.2

DEFINITIONS AND ABBREVIATIONS

The following terms may be met in these Technical Schedules and shall be interpreted as follows:

Hz	shall mean hertz
	shall mean kilowatt
MW	shall mean megawatt
VA (kVA, MVA)	shall mean volt-ampere (kilo-, mega-)
A (kA)	shall mean ampere (kilo-)
V (kV)	shall mean volt (kilo-)
W/m	shall mean watt per metre
AC	shall mean alternating current
DC	shall mean direct current
I_N	shall mean rated (nominal) current
U_N	shall mean rated (nominal) voltage
Ah	shall mean ampere-hours
lm	shall mean lumen
lm/w	shall mean lumen per watt
min	shall mean minute
min.	shall mean minimum
(prefix)	shall mean micro
rms	shall mean root mean square
p.u.	shall mean per unit
p/p	shall mean peak to peak
T	shall mean Tesla
kg	shall mean kilogram
N	shall mean Newton
s or sec.	shall mean second
No.	shall mean number
dB	shall mean decibel
Amp	shall mean amperes
F	shall mean Farad
°C	shall mean centigrade
K	shall mean degree Kelvin
m^2	shall mean square metre (mm^2 for millimetre,
m^3	shall mean cubic metre (mm^3 for millimetre, etc)
m^3/s	shall mean cubic metres per second
m	shall mean metre
cm	shall mean centimetre
	shall mean millimetre
joules	shall mean joules per hour
tonne	shall mean metric tonne
%	shall mean percentage
Pascal	1 N/ m^2
cst	shall mean centistoke

2.11.3 SCHEDULE 'A' - National Standards for Equipment not Complying with IEC Standard Recommendations

<u>Equipment</u>	<u>NationalStandard</u>	<u>EnglishTitle</u>
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.....
.....
.....
.....

**2.11.4 SCHEDULE "B" - DEVIATIONS FROM
THE REQUIREMENTS OF THE SPECIFICATION**

It will be assumed that the equipment offered will conform to the Specification in all respects, unless departures are mentioned in this Schedule.

2.11.5 SCHEDULE 'C' - PRICE SCHEDULES

Preamble

The Price Schedules shall be read in conjunction with the Instructions to Tenderers, General and Special Conditions of Contract and the Technical Specifications.

The rates and prices tendered in the Price Schedules shall, except insofar as it is otherwise provided under the Contract, include all materials, insurance, profit, together with all general risks, liabilities and obligations set out or implied in the contract.

A price shall be entered against each item in the Price Schedules, whether quantities are stated or not. The cost of Items against which the Supplier has failed to enter a rate or price shall be deemed to be covered by the Contract Price.

The whole cost of complying with the provisions of the Contract shall be included in the Items provided, the Price Schedules, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items.

3 PARTICULAR TECHNICAL SPECIFICATIONS FOR POWER TRANSFORMERS

3.1 Technical Specification of Step-down and Step- up Power Transformer

1. Standards

IEC 60076-1 Part 1: General
IEC 60076-2 Part 2: Temperature rise
IEC 60076-3 Part 3: Insulation levels and dielectric tests
IEC 60076-5 Part 5: Ability to withstand short circuit
IEC 60076-7 Part 7: Loading guide for oil-immersed power transformers
IEC 60076-10 Part 10: Determination of sound levels

2. Nominal data

Transformer data have to be according paragraph 20.

3. Temperature rise

Transformer has to be designed for outdoor use. Design ambient temperature is 55°C.
Temperature rises are respectively:

- top oil temperature rise: 45K
- average windings temperature rise: 50K
- hot spot temperature rise: 63K

4. Insulation Levels

Insulation levels have to be according IEC standard.

5. Oil

Transformer shall be filled with a naphtenic uninhibithed oil (Nynäs Nytro Libra or equivalent) with a content of PCB less than 2ppm.

6. Voltage Regulation

Transformers are equipped with on – load tap changer. Regulating range is $\pm 8\%$ in steps of 1.25% of rated voltage. Transformer shall be capable to deliver rated power in each step.

On load tap changer is placed on HV side. It has to be:

- ABB made, type (UBBRN 350/400 A); for Step-up TRs : $11.86/(66 \pm 8*1.25\%)$ kV .
- MR made, type (VIII 400 – D 123/76 – 10193 W); for Step-down TRs : $(66 \pm 8*1.25\%) / 23.5$ kV

On load tap changer shall be placed in a separate oil compartment and equipped with pressure switch, expansion vessel connected to the tap changer through a pipe and shutoff valve.

Tap changer conservator shall be equipped with oil level gauge with contacts for low and high level and a silicagel breather.

It shall be possible to drain oil from tap changer compartment by means with a drain valve.

It shall be possible to operate the tap changer during normal transformer operation. Tap changer operation shall be provided with following controls:

- raise/lower control in order to operate a changing of tap from the motor drive unit
 - a local/remote selector switch
- a hand crank to operate manually a change of tap

It shall be possible to operate the tap from ground level. The tap changer positions shall be visible and marked consecutive with "1" and upwards. The highest ratio corresponds to position "1".

Tap changer shall be equipped with:

- Analogue & digital position indicator
- 4 – 20mA position transmitter. It shall be possible to calibrate the position transmitter in relation to the position.
- a mechanical counter of the total number of tap changer operations.

7. Transformer Tank

The tank of the transformer should be designed to withstand a pressure corresponding to the double height of an oil pillar corresponding to the transformer tanks height. It should be possible to erect/mount/repair the complete tap changer.

Lifting points for hydraulics jacks, clearly marked out in the way they remain after repainting, shall be foreseen under/on the side of the transformer tank.

The tank shall be foreseen with two separate ground connections, 50 – 150 mm² Cu-wire placed in two opposite corners.

8. Cooling equipment

Cooling radiators and brackets shall be hot-dip galvanized and painted. Minimum thickness of galvanization is 55µm.

Radiators shall be constructed for mounting of fans.

Transformers shall be equipped with an adequate number of fans in order to deliver rated power.

9. Expansion vessel

The expansion vessel shall have a volume that allows expansion of minimum 10% of the transformer oil system at the highest allowed oil level.

The expansion vessel shall be equipped with connection for silica gel breather. A valve with male threads shall be located at the lowest point of the expansion vessel.

The expansion vessel shall on one side be equipped with a level gauge with signal contacts for low and high level.

Expansion vessel shall be equipped with a membrane to avoid contacts between oil and air.

10. Drain, filling and sample valves

The transformer shall be equipped with following valves:

- oil drain valve located at the bottom of the tank;
- filling and filter valve located at the top of the tank;
- valves to take oil sample at bottom and top of the tank;

11. Lifting devices

The transformer shall be equipped with lifting hooks for lifting the transformer completely filled with oil. Lifting lugs for lifting cover and active part (core and windings) shall be provided.

12. Buchholz relay

Buchholz relay shall be located between the transformer tank and the expansion vessel. The Buchholz shall be mounted between two shut – off valves. A bypass system shall be provided in order to easily dismount the Buchholz relay, if it is necessary.

The Buchholz relay shall be equipped with separate contacts for slow increasing gas flow and for quick increasing gas flow. The Buchholz shall be equipped with visible scale and contacts and be placed so that it is not possible to damage it by the service personnel. It shall be equipped with valves for taking gas samples and for pressurizing with air in test purpose.

13. Silica gel breathers

Silica gel breathers shall have an inspection window in order to understand status of the silicagel and shall be located at man height. Sufficient amount of silica gel shall be supplied.

14. Bushings

Bushings for insulation level equal or more than 72.5kV shall be condenser type, ABB GOB type. Bushings for insulation level less than 72.5kV can be porcelain – DIN type.

HV connections are overhead bushings.

LV air insulated cable box have to be provided, equipped with connecting bars, flexible links between connecting bars and bushings, support bushings for connecting bars.

Protection degree of LV cable box is IP55.

15. Temperature Indicators

The transformer shall be equipped with thermometer for top oil temperature and for LV& HV windings.

Thermometers shall be equipped with no. (4) separate adjustable contacts and with an indicator of maximum temperature, easily adjustable.

Thermometers shall be mounted on vibration absorbers.

Thermometer sensing element shall be placed in oil tight pockets placed on the transformer cover and it shall be easy to dismount. A spare oil tight pocket on the transformer lid shall be provided.

16. Connection boxes

The transformer shall be equipped with following boxes:

- marshalling box where there are housed terminal blocks of auxiliary devices and circuits for controlling of fans;
- on load tap changer motor drive unit.

Each box has to be made from welded steel plate. Connection boxes shall have extra top cover and shall be ventilated. The boxes shall be equipped with a proper number of terminals), space heaters controlled by thermostat and service light.

Protection degree of connection boxes shall be at least IP55.

17. Auxiliary Cables

All cables between auxiliary devices and marshalling box shall be halogen free cable and putted into a flexible conduit. Each cable shall have a minimum cross section of 1,5 mm². The cores shall be equipped with protection against mechanical damage and protection against walking shoes.

18. Erection, mounting and transportation

The transformers shall be transformers shall be placed on concrete foundation. Transformer

has to be equipped with an impact recorder in order to monitor forces during shipping.

19. Performance and test

Routine, type and special tests specified in the purchase order shall be performed on the transformer.

All tests will be performed according IEC 60076.

IEC tolerances are applicable for load and no load losses.

20. Transformer datasheets

a. Step-down Power TR

Item	Description	Unit	Required Specification	Offered Specification
	" 20/25 MVA, 66 / (23.5 ± 8*1.25%) kV, Dyn11, 50 Hz, equipped with O.L.T.C. - MR type; with the following :-		From Eligible country	
1	Continuous maximum rating on any tapping when operation under the ambient conditions:			
1.1	With ONAN cooling			
1.2	HV winding	MVA	20	
1.3	LV winding	MVA	20	

1.4	With ONAF cooling:			
1.5	HV winding	MVA	25	
1.6	LV winding	MVA	25	
2	Rated frequency	Hz	50	
3	Rated no-load voltages at rated frequency on:			
3.1	HV, principal tapping ,	KV	66	
3.2	HV extreme plus tapping	KV	72.6	
3.3	HV, extreme minus tapping	KV	59.4	
3.4	LV,	KV	23.5	
4	Tapping ranges from principal tapping			
4.1	HV, no of plus tappings	-	8	
4.2	HV, no of minus tappings	-	8	
4.3	HV, stcps in % of rated voltage	%	1.25	
5	No-load losses at rated voltage and frequency	KW	20	
6	No-load current at rated voltage and ,frequency	A	1.6	
7	Load losses at 95°C at rated currents, the third winding being open:			
7.1	HV - LV,ONAN	KW	59.5	
7.2	HV - LV, ONAF	KW	93	
8	Cooling plant power consumption	KW	5.4	
9	Total losses at 95°C on principal taping and unity power factor and rated currents:			
9.1	ONAN	KW	79.5	
9.2	ONAF including input to cooling plant:.	KW	116.6	
10	Impedance voltages at 75° referred to mutual capacities at rated frequency and 100% rating:		10%	
10.1	Principal tapping:			
10.2	HV - LV, ONAN	%	8	
10.3	HV - LV, ONAF	%	10	
10.4	Extreme plus tapping:			
10.5	HV - LV, ONAN	%	8.3	
10.6	HV - LV, ONAF	%	10.4	

10.7	Extreme minus tapping:			
10.8	HV - LV, ONAN	%	8.1	
10.9	HV - LV, ONAF	%	10.2	
11	Temperature rise after continuous operation with rated MVA, under the ambient conditions and the rated conditions giving the highest losses:			
11.1	Top oil (by thermometer)	°C	45	
11.2	Windings (by resistance)	°C	50	
12	Efficiency on principal tapping max. temperature of winding and unity power factor			
12.1	125% load, ONAN	%	99.57	
12.2	100% load, ONAN	%	99.62	
12.3	50% load, ONAN	%	99.68	
12.4	125% load, ONAF	%	99.5	
12.5	100% load, ONAF	%	99.57	
12.6	50% load, ONAF	%	99.67	
13	Inherent voltage regulation on principal tapping, 75°C and unity power factor:			
13.1	80% of full load on LV		0.6	
14	Inherent voltage regulation on principal tapping, 75°C and 0.8 power factor lagging:			
14.1	80% of full load on LV		5.18	
15	Vector group		Dyn11	
16	No. of phases per transformer		3	
17	Type of cooling		ONAN / ONAF	
18	Whether star connected windings shall be fully insulated or graded			
18.1	HV winding			
18.2	LV winding		Full insulated	
19	Insulation levels of star points			
19.1	HV winding	KV	–	
19.2	LV winding	KV	50	
20	Method of system earthing:			
20.1	HV system			
20.2	LV system		solid	

21	Method of transformer earthing:			
21.1	HV windings - star point		-	
21.2	LV windings - star point		Brought out	
23	Indoor or outdoor installation		outdoor	
24	System highest voltage according to IEC:			
24.1	HV	KV	76	
24.2	LV	KV	24	
25	Maximum flux density at rated voltage on principal tapping and rated frequency:			
25.1	Transformer legs	T	1.6	
25.2	Transformer yokes	T	1.6	
26	Maximum flux density at most onerous voltage and frequency conditions:			
26.1	Transformer legs	T	1.6	
26.2	Transformer yokes	T	1.6	
27	Specific core loss	W/kg	1.12	
28	Maximum current density in windings at rated output:			
28.1	HV, higher voltage, ON AN		≤ 2.5	
28.2	HV, lower voltage, ONAF		≤ 2.5	
28.3	LV, ONAN	A/mm ²	≤ 2.5	
28.4	LV, ONAF	A/mm ²	≤ 2.5	
29	Maximum current at rated normal voltage on principal ,tapping	A	218.7	
30	Maximum hot spot temperature of winding	°C	60 (over ambient)	
31	Equivalent resistance referred to HV side	ohms	0.82	
32	Equivalent reactance referred to HV side	ohms	17.4	
33	Maximum current carrying capacity of bushings:			
33.1	HV	A	1250	
33.2	LV	A	2000	
34	Rated service voltage of bushings:			
34.1	HV	KV	72.5	
34.2	LV	KV	24	
34.3	HV, neutral	KV		
34.4	LV, neutral	KV	24	
35	1 minute, 50 Hz dry withstand voltage:			

35.1	HV bushing	KV	140	
35.2	LV bushing	KV	50	
35.3	HV, LV neutral bushings	KV	50	
36	1 minute, 50 Hz wet withstand voltage:			
36.1	HV bushing	KV		
36.2	LV bushing	KV		
36.3	HV, LV neutral bushings	KV		
37	Impulse withstand voltage			
37.1	HV bushing	KV	325	
37.2	LV bushing	KV	125	
38	Maximum noise level			
38.1	Transformer and tap changing equipment energized and at no-load with ONAN cooling			
38.2		dB	<73	
38.3	Same as above but with ONAF cooling (fans fanning)	dB	<73	

b. Step-up Power TR

Item	Description	Unit	11/66KV
	20/25 MVA 11.86/ 66 KV (± 8 x 1.25 %) KV , Ynd11 , 50 Hz , equipped with (O.L.T.C) . With the following :-	NO.	2
1	Continuous maximum rating on any tapping when operation under the ambient conditions:		
	With ONAN cooling		
	HV winding	MVA	20
	LV winding	MVA	20
	With ONAF cooling:		
	HV winding	MVA	25
	LV winding	MVA	25
2	Rated frequency	Hz	50
3	Rated no-load voltages at rated frequency on:		
	HV, principal tapping ,	KV	66 KV
	HV extreme plus tapping	KV	72.6 KV
	HV, extreme minus tapping	KV	59.4 KV
	LV,	KV	11.86 KV
4	Tapping ranges from principal tapping		
	HV, no of plus tappings	-	8
	HV, no of minus tappings	-	8
	HV, steps in % of rated voltage	%	1.25
5	No-load losses at rated voltage and frequency	KW	19

6	No-load current at rated voltage and ,frequency	A	15
7	Load losses at 95°C at rated currents,the third winding being open:		
	HV - LV,ONAN	KW	59.5
	HV - LV, ONAF	KW	93.5
8	Cooling plant power consumption	KW	5.4
9	Total losses at 95°C on principal tapping and unity power factor and rated currents:		
	ONAN	KW	73.5
	ONAF including input to cooling plant:.	KW	115.1
10	Impedance voltages at 75° referred to mutual capacities at rated frequency and 100% rating:		
	Principal tapping:		
	HV - LV, ONAN	%	8
	HV - LV, ONAF	%	10
	Extreme plus tapping:		
	HV - LV, ONAN	%	8.32
	HV - LV, ONAF	%	10.4
	Extreme minus tapping:		
	HV - LV, ONAN	%	8.2
	HV - LV, ONAF	%	10.28
11	Temperature rise after continuous operation with rated MVA, under the ambient conditions and the rated conditions giving the highest losses:		
	Top oil (by thermometer)	°C	45
	Windings (by resistance)	°C	50
12	Efficiency on principal tapping max. temperature of winding and unity power factor		
	120% load, ONAN	%	99.61
	100% load, ONAN	%	99.65
	50% load, ONAN	%	99.69
	120% load, ONAF	%	99.55
	100% load, ONAF	%	99.62
	50% load, ONAF	%	99.69
13	Inherent voltage regulation on principal tapping. 75°C and unity power factor:		
	80% of full load on LV	%	0.57
14	Inherent voltage regulation on principal tapping. 75°C and 0.8 power factor lagging:		
	80% of full load on LV	%	5.15
15	Vector group		Ynd11
16	No. of phases per transformer		3
17	Type of cooling		ONAN/ONAF
18	Whether star connected windings shall be fully insulated or graded		

	HV winding		fully insulated
	LV winding		—
19	Insulation levels of star points		
	HV winding	KV	325.14
	LV winding	KV	—
20	Method of system earthing:		
	HV system		solid
	LV system		
21	Method of transformer earthing:		
	HV windings - star point		brought out
	LV windings - star point		—
23	Indoor or outdoor installation		outdoor
24	System highest voltage according to IEC:		
	HV	KV	76
	LV	KV	12
25	Maximum flux density at rated voltage on principal tapping and rated frequency:		1.6 Tesla
	Transformer legs	T	1.6
	Transformer yokes	T	1.6
26	Maximum flux density at most onerous voltage and frequency conditions:		
	Transformer legs	T	1.6
	Transformer yokes	T	1.6
27	Specific core loss	W/kg	1.12
28	Maximum current density in windings at rated output:		
	HV, higher voltage, ON AN		≤2.5
	HV, lower voltage, ONAF		≤2.5
	LV, ONAN	A/mm ²	≤2.5
	LV, ONAF	A/mm ²	≤2.5
29	Maximum current at rated normal voltage on principal tapping	A	218.7
30	Maximum hot spot temperature of winding	°C	60 over ambient
31	Equivalent resistance referred to HV side	ohms	0.903
32	Equivalent reactance referred to HV side	ohms	17.22
33	Maximum current carrying capacity of bushings:		
	HV	A	1250
	LV	A	3150
34	Rated service voltage of bushings:		
	HV	KV	72.5
	LV	KV	24
	HV, neutral	KV	72.5
	LV, neutral	KV	
35	1 minute, 50 Hz dry withstand voltage:		
	HV bushing	KV	140
	LV bushing	KV	50
	HV, LV neutral bushings	KV	140

36	1 minute, 50 Hz wet withstand voltage:		
	HV bushing	KV	
	LV bushing	KV	
	HV, LV neutral bushings	KV	
37	Impulse withstand voltage		
	HV bushing	KV	325
	LV bushing	KV	125
38	Maximum noise level		
	Transformer and tap changing		
	equipment energized and at no-load with ONAN cooling	dB	<72.08
	Same as above but with ONAF cooling (fans funning)	dB	<73

3.2 SCHEDULES

3.2.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Section – Power Transformers:	
Item: Step Up Power Transformers (11/66 kV), (20/25 MVA - ONAN/ONAF)	
Item: Step Down Power Transformers (66/22 kV), (20/25 MVA - ONAN/ONAF)	
Item: Spare Parts	

3.2.2 SCHEDULE 'B' - MANUFACTURERS, PLACES OF MANUFACTURE AND INSPECTION.

Item	Manufacturer	Place of Manufacture	Place of Inspection
Power Transformers:			
Item: Step Up Power Transformers (11/66 kV), (20/25 MVA - ONAN/ONAF)			
Item: Step Down Power Transformers (66/22 kV), (20/25 MVA - ONAN/ONAF)			
Item: Spare Parts			

3.2.3 SCHEDULE 'C' - DRAWINGS

Drawings to be Submitted with the Tender

General Dimension - Layout

Name plate

Protection devices

Type test reports are to be submitted for all equipment.

Drawings to be Submitted for Approval after Award of Contract

General Dimension - Layout

Name plate

Protection devices

The winning contractor should take into his consideration that the new design of upgrading works should be interfaced and integrated with the existing circuit diagrams. Accordingly, he should conduct all necessary communications and coordination that might be needed with the previous contractors who worked on this project in the past (EGEMAC/Egypt and ABB/Sweden) for any required feedbacks, technical clarifications, etc...

Such cost of interfacing and integrating of the new with the old shall be considered within the corresponding unit rate in the bill.

As Built Documentations/ Drawings:

Upon completion of the works; the winning Contactor shall reach ABB AB – Substations / Sweden to update and verify all the existing as built documentation / drawings for the entire Gaza West Substations, and he shall include all the incurred expenses within his quoted prices.

4 Technical Specifications of 220 KV Equipment

This chapter covers the particular technical requirements of 220 KV equipment to be procured under this contract. By conflict between the general specification and the particular specifications below the particular specifications shall prevail.

General

This Section covers the manufacture and supply of 220 KV equipment, associated equipment and spares.

Delivery on Supply Basis

The Supply shall cover Engineering, design, manufacture, testing before shipment and packing sea worthy or otherwise as required, delivery DDU

4.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY (RMU)

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Section – 220 KV equipments	
Items: POWER TRANSFORMER (CONTROL & PROTECTION) PANEL	
Items: ACCESSORIES FOR PARALLEL OPERATION OF POWER TRANSFORMERS	
Items: ADDITIONAL TRANSFORMER BAY (DT1)	
Items: EARTHING	

4.2 SCHEDULE 'B' -TECHNICAL GUARANTEES, 220 KV EQUIPMENTS

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 1 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	Circuit Breaker (Type LTB 245 E1)			
	Rated Voltage	kV	245	
	Maximum service voltage	kV	245	
	Rated frequency	Hz	50	
	Rated continuous current	A	4000	
	- One minute power frequency withstand voltage, dry and wet.			
	- to earth	kV rms	460	
	- across open breaker pole	kV rms	460	
	- impulse withstand voltage 1.2/50 ms			
	- to earth	kV peak	1050	
	- across open breaker	kV peak	1050	
	- Breaking capacity at Rated voltage			
	- symmetrical	kA rms	40	
	- asymmetrical	kA rms	51	
	- making capacity	kA peak	100	
	- Breaking capacity of capacitive current	A	*	
	- Over voltage factor for disconnection of unloaded transformers (without voltage limitation by lightning arresters)		2 p.u	
	- Rated inductive current switching capacity	A kV peak	10-20	
	- Switching surge withstand voltage to ground, dry and wet	kA rms	N/A	
	- Permissible 1 second short-time current	kA peak	40	
	- Dynamic short-time current	m.sec	100	
	- Opening time, interval of time between the instant of application of tripping impulse to the instant when the main contacts have separated in all poles		17±2	
	- Make time ,interval of time between the initiation of closing operation and the instant when the current begins to flow in the main circuit		≤28	

* 250 A cable
125 A lines
1000 A banks

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 2 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Total break time ,interval of time between the instant of application of tripping impulse to the instant of final arc extinction in all poles			
	- at 100% breaking capacity	m.sec	40	
	- under phase opposition	m.sec	40	
	- Dead time (for rapid autoreclosing) interval of time between final arc extinction in all poles on the opening operation and the first re-establishment of current in any pole in the subsequent closing operation	m.sec	300	
	- Maximum arc duration for			
	- 3-phase symmetrical	m.sec	20	
	- 1-phase	m.sec	20	
	- Minimum corona starting voltage of closed and open circuit breaker (voltage to earth)	kV	156	
	- Rate of rise of recovery voltage (RRRV) at 100% short circuit current			
	- 3-phase			
	- 1-phase	kV/m.sec	2.0	
	- RRRV out of phase duty		2.0	
	- Minimum temperature rise at rated current of main contact	kV/m.sec	1.54	
	- Specific creepage distance across insulator	°C	48.7	
	- Bending moment at base of support insulator	mm/kV	31	
	- Bending moment at base of support structure	kNm	28	
	- Isolating and earthing Switches	kNm	100	
	- Rated voltage			
	- Maximum service voltage	kV		
	- Rated frequency	kV		
		Hz		

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 2 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Total break time ,interval of time between the instant of application of tripping impulse to the instant of final arc extinction in all poles			
	- at 100% breaking capacity	m.sec		
	- under phase opposition	m.sec		
	- Dead time (for rapid autoreclosing) interval of time between final arc extinction in all poles on the opening operation and the first re-establishment of current in any pole in the subsequent closing operation	m.sec		
	- Maximum arc duration for			
	- 3-phase symmetrical	m.sec		
	- 1-phase	m.sec		
	- Minimum corona starting voltage of closed and open circuit breaker (voltage to earth)	kV		
	- Rate of rise of recovery voltage (RRRV) at 100% short circuit current			
	- 3-phase	kV/m.sec		
	- 1-phase	kV/m.sec		
	- RRRV out of phase duty			
	- Minimum temperature rise at rated current of main contact	°C		
	- Specific creepage distance across insulator	mm/kV		
	- Bending moment at base of support insulator	kN		
	- Bending moment at base of support structure	kN		
	- Isolating and earthing Switches			
	- Rated voltage		SGF 245	
	- Maximum service voltage	kV	245	
	- Rated frequency	kV	245	
		Hz	50	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 3 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Rated continuous current of isolating switches	A	2500	
	- Switching capability of capacitive current			
	- making	A	1.5	
	- breaking	A	1.5	
	- Rated short-time current 1 sec.			
	- isolating switch	kA rms	40	
	- earthing switch	kA rms	40	
	- Rated short-time current			
	- isolating switch			
	- earthing switch			
	- Impulse withstand voltage			
	- to earth	kA peak	1050	
	- across the isolating distance	kA peak	1200	
	- One minute power frequency withstand voltage			
	- to earth	kV rms		
	- across the isolating distance	kV rms		
	- switching surge withstand voltage			
	- to earth	kV peak	-	
	- across the isolating distance	kV peak	-	
	- Minimum corona starting voltage at any end position of isolating and earthing switch (voltage to earth)	kV	156	Voltage which below corona is not visible
	- Maximum temperature rise of current carrying parts at rated current			
	- isolating switch	°C	61K	(on contacts)
	- earthing switch	°C	-	
	- Opening time	sec.	3.5-6	
	- Closing time	sec.	3.5-6	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 3 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Rated continuous current of isolating switches	A	2500	
	- Switching capability of capacitive current			
	- making	A	1.5	
	- breaking	A	1.5	
	- Rated short-time current 1 sec.			
	- isolating switch	kA rms	40	
	- earthing switch	kA rms	40	
	- Rated short-time current			
	- isolating switch	kA peak	100	
	- earthing switch	kA peak	100	
	- Impulse withstand voltage			
	- to earth	kA peak	1050	
	- across the isolating distance	kA peak	1200	
	- One minute power frequency withstand voltage			
	- to earth	kV rms	460	
	- across the isolating distance	kV rms	530	
	- switching surge withstand voltage			
	- to earth	kV peak	-	
	- across the isolating distance	kV peak	-	
	- Minimum corona starting voltage at any end position of isolating and earthing switch (voltage to earth)	kV	156	Corona inspection voltage
	- Maximum temperature rise of current carrying parts at rated current			
	- isolating switch	°C	62K	(on contacts)
	- earthing switch	°C	-	
	- Opening time	sec.	8-12	
	- Closing time	sec.	8-12	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV	25	Cantilever failing load of insulator
	- Bending moment at base of support insulator	kN	4000	
	- Bending moment at base of support structure	kN	-	
	Current transformer Type------(to be filled In for each type transformer)			
	- Rated voltage	kV		
	- Maximum service voltage	kV		
	- Rated frequency			
	- One minute power frequency test voltage of			
	- Primary winding	kV rms		
	- Secondary winding	kV rms		
	- Lightning impulse withstand voltage	kv peak		
	- switching impulse withstand voltage	kv peak		
	- Rated primary current	A		
	- Rated secondary current	A		
	- Short-time thermal rating			
	- 1 second	kA rms		
	- Short-time dynamic rating	kA peak		
	- Temperature rise for continuous full load operation			
	- in the windings	°C		
	- in the coil	°C		
	- Thermal current rating factor			
	- Burden and accuracy class of			
	- measuring core			
	- protection core			
	- busbar protection core			

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV	25	Cantilever failing load of insulator
	- Bending moment at base of support insulator	kN	6	
	- Bending moment at base of support structure	kN	-	
	Current transformer Type------(to be filled In for each type transformer)			
	- Rated voltage	kV		
	- Maximum service voltage	kV		
	- Rated frequency			
	- One minute power frequency test voltage of			
	- Primary winding	kV rms		
	- Secondary winding	kV rms		
	- Lightning impulse withstand voltage	kv peak		
	- switching impulse withstand voltage	kv peak		
	- Rated primary current	A		
	- Rated secondary current	A		
	- Short-time thermal rating			
	- 1 second	kA rms		
	- Short-time dynamic rating	kA peak		
	- Temperature rise for continuous full load operation			
	- in the windings	°C		
	- in the coil	°C		
	- Thermal current rating factor			
	- Burden and accuracy class of			
	- measuring core			
	- protection core			
	- busbar protection core			

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV		
	- Bending moment at base of support insulator	kN		Cantilever failing load of insulator
	- Bending moment at base of support structure	kN		
	Current transformer Type IMB 245 (to be filled In for each type transformer)			
	- Rated voltage	kV	245	
	- Maximum service voltage	kV	245	
	- Rated frequency	Hz	50	
	- One minute power frequency test voltage of			
	- Primary winding	kV rms	460	
	- Secondary winding	kV rms	2.5	Test 4
	- Lightning impulse withstand voltage	kv peak	1050	
	- switching impulse withstand voltage	kv peak	N/A	
	- Rated primary current	A	200-400	
	- Rated secondary current	A	1	
	- Short-time thermal rating			
	- 1 second	kA rms	40	
	- Short-time dynamic rating	kA peak	102	
	- Temperature rise for continuous full load operation			
	- in the windings	°C	65	
	- in the coil	°C	65	
	- Thermal current rating factor		1.2	
	- Burden and accuracy class of			
	- measuring core		5VA 0.2s fs	
	- protection core		8	
	- busbar protection core		25 VA	
			5P20	
			500/0.1/2	(V/A/Ohm)

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV		
	- Bending moment at base of support insulator	kN		
	- Bending moment at base of support structure	kN		
	Current transformer Type IMB 245 (to be filled In for each type transformer)			
	- Rated voltage	kV	245	
	- Maximum service voltage	kV	245	
	- Rated frequency	Hz	50	
	- One minute power frequency test voltage of			
	- Primary winding	kV rms	460	Test 4
	- Secondary winding	kV rms	2.5	
	- Lightning impulse withstand voltage	kv peak	1050	
	- switching impulse withstand voltage	kv peak	N/A	
	- Rated primary current	A	200-400	
	- Rated secondary current	A	1	
	- Short-time thermal rating			
	- 1 second	kA rms	40	
	- Short-time dynamic rating	kA peak	102	
	- Temperature rise for continuous full load operation			
	- in the windings	°C	65	
	- in the coil	°C	65	
	- Thermal current rating factor		1.2	
	- Burden and accuracy class of			
	- measuring core		5VA 1.0 fs	
	- protection core		5	
	- busbar protection core		25 VA	
			5P20	
			500/0.1/2	(V/A/Ohm)

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV		
	- Bending moment at base of support insulator	kN		
	- Bending moment at base of support structure	kN		
	Current transformer Type IMB 245 (to be filled In for each type transformer)			
	- Rated voltage	kV	245	
	- Maximum service voltage	kV	245	
	- Rated frequency	Hz	50	
	- One minute power frequency test voltage of			
	- Primary winding	kV rms	460	Test 4
	- Secondary winding	kV rms	2.5	
	- Lightning impulse withstand voltage	kv peak	1050	
	- switching impulse withstand voltage	kv peak	N/A	
	- Rated primary current	A	400-800	
	- Rated secondary current	A	1	
	- Short-time thermal rating			
	- 1 second	kA rms	40	
	- Short-time dynamic rating	kA peak	102	
	- Temperature rise for continuous full load operation			
	- in the windings	°C	65	
	- in the coil	°C	65	
	- Thermal current rating factor		1.2	
	- Burden and accuracy class of			
	- measuring core		5VA 0.25 fs	
	- protection core		5 25 VA 5P20	
	- busbar protection core		490/0.04/5	(V/A/Ohm)

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 4 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV		
	- Bending moment at base of support insulator	kN		
	- Bending moment at base of support structure	kN		
	Current transformer Type IMB 245 (to be filled In for each type transformer)			
	- Rated voltage	kV	245	
	- Maximum service voltage	kV	245	
	- Rated frequency	Hz	50	
	- One minute power frequency test voltage of			
	- Primary winding	kV rms	460	
	- Secondary winding	kV rms	2.5	Test 4
	- Lightning impulse withstand voltage	kv peak	1050	
	- switching impulse withstand voltage	kv peak	N/A	
	- Rated primary current	A	2000	
	- Rated secondary current	A	1	
	- Short-time thermal rating			
	- 1 second	kA rms	40	
	- Short-time dynamic rating	kA peak	102	
	- Temperature rise for continuous full load operation			
	- in the windings	°C	65	
	- in the coil	°C	65	
	- Thermal current rating factor		1.2	
	- Burden and accuracy class of			
	- measuring core		5VA 1.0 fs	
	- protection core		8	
	- busbar protection core		25 VA	
			5P20	
			640/0.02/10	(V/A/Ohm)

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 5 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Instrument security factor of the measuring core		fs 8	
	- accuracy limit factor of the			
	- Protection core		5P20	
	- busbar protection core		-	
	- Permitted static load (primary terminals)	kN kN	4	
	- Permitted dynamic load (primary terminals)	mm/kN	5.6	
	- Specific creepage distance across insulator	mm	7700	
	- Arcing distance across insulator		3170	
	Voltage transformer, Type-----	kV		
	- Rated voltage	kVrms		
	- Maximum service voltage			
	- One-minute power frequency test voltage of	kVrms		
	- Primary winding	kVrms		
	- secondary winding	kV peak		
	- Lightning impulse withstand voltage	kV peak		
	- Switching impulse withstand voltage	°C		
	- Temperature rise for continuous full load operation	°C		
	- capacitor	°C		
	- secondaries			
	- oil			
	- Burden and accuracy class of	kV		
	- measuring winding	pF		
	- protection winding	kN		
	- Ratio	kN		
	- Capacitance			
	- Permitted static load (primary terminals)			
	- Permitted dynamic load (primary terminals)			

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 5 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Instrument security factor of the measuring core			
	- accuracy limit factor of the			
	- Protection core			
	- busbar protection core			
	- Permitted static load (primary terminals)	kN kN		
	- Permitted dynamic load (primary terminals)	mm/kN		
	- Specific creepage distance across insulator	mm		
	- Arcing distance across insulator			
	Voltage transformer, Type CPA 245	kV		
	- Rated voltage	kVrms	220/V3	
	- Maximum service voltage		245	
	- One-minute power frequency test voltage of	kVrms		
	- Primary winding	kVrms	460	
	- secondary winding	kV peak	2.5	test 4
	- Lightning impulse withstand voltage	kV peak	1050	
	- Switching impulse withstand voltage	°C	N/A	
	- Temperature rise for continuous full load operation	°C		
	- capacitor		<20	
	- secondaries		<65	
	- oil		<55	
	- Burden and accuracy class of	kV		
	- measuring winding		1-50 0.2	
	- protection winding		1-50 3P	
	- Ratio	pF	110/V3;	
		kN	110/V3;	
		kN	110/V3;	
	- Capacitance		7400	
	- Permitted static load (primary terminals)		2.0	
	- Permitted dynamic load (primary terminals)		2.0	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 5 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Instrument security factor of the measuring core		fs 8	
	- accuracy limit factor of the			
	- Protection core		5P20	
	- busbar protection core		-	
	- Permitted static load (primary terminals)	kN kN	4	
	- Permitted dynamic load (primary terminals)	mm/kN	5.6	
	- Specific creepage distance across insulator	mm	7700	
	- Arcing distance across insulator		3170	
	Voltage transformer, Type CPA 245	kV		
	- Rated voltage	kVrms		
	- Maximum service voltage			
	- One-minute power frequency test voltage of	kVrms		
	- Primary winding	kVrms		
	- secondary winding	kV peak		
	- Lightning impulse withstand voltage	kV peak		
	- Switching impulse withstand voltage	°C		
	- Temperature rise for continuous full load operation	°C		
	- capacitor	°C		
	- secondaries			
	- oil			
	- Burden and accuracy class of	kV		
	- measuring winding			
	- protection winding			
	- Ratio	pF		
	- Capacitance	kN		
	- Permitted static load (primary terminals)	kN		
	- Permitted dynamic load (primary terminals)			

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 6 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Specific creepage distance across insulator	mm/kV	8200	
	- Arcing distance across insulator	mm	3260	
	- Lightning Arresters, Type _____			
	- Rated voltage	kV rms		
	- Maximum continuous operating voltage	kV rms		
	- Rated frequency	Hz		
	- Rated discharge current	kA		
	- Line discharge class			
	- Impulse withstand current, 4/10 ms	kA		
	- Pressure relief capability to IEC 99-1, 1970 at			
	- 0.2 sec. fault duration	kA rms		
	- 0.1 sec. fault duration	kA rms		
	- Maximum residual voltage with the following values of discharge current at 8/20 ms:			
	- 5 kA	kV		
	- 10 kA	kV		
	- 20 kA	kV		
	- Line Traps, Type _____			
	- Rated inductance	mH A		
	- Rated continuous current	mH		
	- Power frequency inductance	kHz		
	- Carrier frequency bandwidth	kHz		
	- Centre frequency	dB		
	- Tapping loss (max)	kV		
	- Impulse withstand voltage	peak		
	- Rated 1 sec. thermal current	kA		
	- Rated short time dynamic current for the tuning device	kA		
	- Rated impulse withstand level	kV		
		peak		

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 6 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
-	Specific creepage distance across insulator	mm/kV		
-	Arcing distance across insulator	mm		
-	Lightning Arresters, Type _____			
-	Rated voltage	kV rms	192	
-	Maximum continuous operating voltage	kV rms	154	
-	Rated frequency	Hz	50	
-	Rated discharge current	kA	10	
-	Line discharge class		(nominal)	
-	Impulse withstand current, 4/10 ms	kA	3	
-	Pressure relief capability to IEC 99-1, 1970 at		100	
-	0.2sec.faultduration *1	kA rms	CL.5.11	
-	0.1sec.faultduration *2	kA rms	65 kA	
-	Maximum residual voltage with the following values of discharge current at 8/20 ms:		0.8 kA	
-	- 5 kA	kV	429	
-	- 10 kA	kV	452	
-	- 20 kA	kV	497	
-	Line Traps, Type _____			
-	Rated inductance	mH A		
-	Rated continuous current	mH		
-	Power frequency inductance	kHz		
-	Carrier frequency bandwidth	kHz		
-	Centre frequency	dB		
-	Tapping loss (max)	kV		
-	Impulse withstand voltage	peak		
-	Rated 1 sec. thermal current	kA		
-	Rated short time dynamic current for the tuning device	kA		
-	Rated impulse withstand level	kV		
-		peak		

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 7 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Power frequency test voltage for the protective devices	kV		
	- Maximum continuous operating voltage	kV		
	- discharge class (1-5)			
	Insulator (Post Type)			
	- General particulars:			
	- disc diameter	mm	265-285	
	- spacing	mm	-	
	- leakage distance	mm	7595	
	- arcing distance	min. mm		
	- Mechanical characteristics:			
	- maximum working load	kN	10	
	- electro- mechanical strength	kN	-	
	- breaking load	kN	>10	
	- impact strength	kN	-	
	- Electrical characteristics:			
	- one minute dry test voltage	kV	1050	
	- min. dry flash- over voltage	kV	>1050	
	- min. rain test voltage	kV	460	
	- min. rain flash- over test	kV		
	-x) negative 50% impulse flash-over voltage	kV		
	-x) positive 50% impulse flash-over voltage	kV		
	- puncture voltage	kV		
	- radio influence voltage of kHz			
	x) The insulator is subjected to a positive and negative 1 1/2/40 ms and the voltage is increased to the 50% impulse flash-over voltage. This value if verified by the application of at lease 20 impulses.	kV V		
			Note deviations	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 8 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	Conductors			
	a. Line Bay			
	- Conductor section	mm ²	774	
	- Conductor Diameter	mm	36.2	
	- Number of Wires		61	
	- DC resistance at 20C	Ohm/km	0.0374	
	- Modulus of elasticity	N/mm ²	60000	
	- Ultimate specific strength	kN/mm ²	0.166	
	- Thermal Coefficient of expansion.	°C-1	23x10 ⁻⁶	
	b. Transformer Bay			
	- Conductor section	mm ²	774	
	- Conductor Diameter	mm	36.2	
	- Number of Wires		61	
	- DC resistance at 20C	Ohm/km	0.374	
	- Modulus of elasticity	N/mm ²	60000	
	- Ultimate specific strength	kN/mm ²	0.166	
	- Thermal Coefficient of expansion.	°C-1	23x10 ⁻⁶	
	c. Busbars (Tubes)			
	- Conductor section	mm ²	3036	
	- Conductor Diameter	mm	200/190	
	- Number of Wires		N/A	
	- DC resistance at 20C	Ohm/km	0.0109	
	- Modulus of elasticity	N/mm ²	70000	
	- Ultimate specific strength	kN/mm ²	0.17	
	- Thermal Coefficient of expansion. Overhead wire (to be the same for all substations)	°C-1	23x10 ⁻⁶	
	- Conductor section	mm ²	157	
	- Conductor Diameter	mm	16.3	
	- Number of Wires		19	
	- DC resistance at 20C	Ohm/km	0.181	

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 8 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	Conductors			
	a.Line Bay			
	- Conductor section	mm ²	Tube 100/92	
	- Conductor Diameter	mm		
	- Number of Wires			
	- DC resistance at 20C	Ohm/km		
	- Modulus of elasticity	N/mm ²		
	- Ultimate specific strength	kN/mm ²		
	- Thermal Coefficient of expansion.	°C-1		
	b.Transformer Bay			
	- Conductor section	mm ²	Tube 100/92	
	- Conductor Diameter	mm		
	- Number of Wires			
	- DC resistance at 20C	Ohm/km		
	- Modulus of elasticity	N/mm ²		
	- Ultimate specific strength	kN/mm ²		
	- Thermal Coefficient of expansion.	°C-1		
	c. Busbars (Tubes)			
	- Conductor section	mm ²	1206	
	- Conductor Diameter	mm	100/92	
	- Number of Wires		N/A	
	- DC resistance at 20C	Ohm/km	0.0276	
	- Modulus of elasticity	N/mm ²	70000	
	- Ultimate specific strength	kN/mm ²	0.17	
	- Thermal Coefficient of expansion. Overhead wire (to be the same for all substations)	°C-1	23x10 ⁻⁶	
	- Conductor section	mm ²		
	- Conductor Diameter	mm		
	- Number of Wires			
	- DC resistance at 20C	Ohm/km		

Upgrading works of the existing Gaza Power Plant & Gaza West Substation		Control & Switchgear		
220 kV Switchyards		Sheet 9 of 9		
Item	Particulars	Unit	Guar. Fig	Tolerance
	- Modulus of elasticity	kN/mm ²	60	
	- Ultimate specific strength	kN/mm ²	0.174	
	- Thermal Coefficient of expansion.	°C ⁻¹	23x10 ⁻⁶	
	Accessories			
	Minimum corona starting voltage of the accessories used (terminal clamps, connectors ,etc)	kV	170	
	Manufacturer's Name			
	- Circuit breakers			
	- Isolating switches			
	- Current transformers			
	- Voltage transformers			NGK /Ceram Tec. Elektrokop/ Lumpi/ SAPA
	- Lightning arresters			
	- Line traps			
	- Insulators			
	- Conductors			
	Country of Manufacture			
	- Circuit breakers			
	- Isolating switches			
	- Current transformers			
	- Voltage transformers			Japan/Germany Sweden /Austria/Sweden
	- Lightning arresters			
	- Line traps			
	- Insulators			
	- Conductors			

4.3 SCHEDULE 'C' - DRAWINGS

Drawings to be Submitted with the Tender

Details and dimensions of the 220 KV equipments. Type test reports are to be submitted for all equipment.

Drawings to be Submitted for Approval after Award of Contract

Details and dimensions of the 220 KV equipments.

The winning contractor should take into his consideration that the new design of upgrading works should be interfaced and integrated with the existing circuit diagrams. Accordingly, he should conduct all necessary communications and coordination that might be needed with the previous contractors who worked on this project in the past (EGEMAC/Egypt and ABB/Sweden) for any required feedbacks, technical clarifications, etc...

Such cost of interfacing and integrating of the new with the old shall be considered within the corresponding unit rate in the bill.

As Built Documentations / Drawings:

Upon completion of the works; the winning Contractor shall reach ABB AB – Substations / Sweden to update and verify all the existing as built documentation / drawings for the entire Gaza West Substations, and he shall include all the incurred expenses within his quoted prices.