

23	INSPECTION AND TESTING.....	2
23.1	GENERAL.....	2
23.1.1	Inspection and Tests at Manufacturer's Place	2
23.1.2	Inspection and Tests at Site.....	3
23.2	ELECTRICAL INSTALLATION TESTING	4
23.2.1	General.....	4
23.2.2	Verification of Polarity	5
23.2.3	Earth Electrode Resistance	5
23.2.4	Insulation Resistance.....	5
23.2.5	Ring Circuit Continuity	6
23.2.6	Phase Rotation	6
23.2.7	Continuity of Protective Conductor.....	6
23.2.8	Earth-fault Loop Impedance.....	6
23.2.9	Operation Tests	6
23.3	ELECTRICAL EQUIPMENT TESTING	7
23.3.1	General.....	7
23.4	COMMISSIONING	8
23.4.1	General.....	8

ARAB ENGINEERING BUREAU

23 INSPECTION AND TESTING

23.1 GENERAL

23.1.1 Inspection and Tests at Manufacturer's Place

- 1 The Engineer shall be authorised to inspect, examine, and test at any reasonable time and in the premises of the manufacturer, the quality of the material used for the equipment to be supplied. These work inspections shall include but not be limited to the following equipment, switchgears, switchboards, motor control centres, main and sub-main distribution boards, Equipment Motors >50 KW,VFDs/AHF(Standalone with P >75 KW), Diesel Generators Sets, GT sets, LV/FBA/MCCs/Switchgears, 11/3.3 KV Switchgears, HV Transformers, UV systems,. He shall also be authorised to verify the qualifications of the staff employed by the manufacturer.
- 2 Should part of the equipment be subcontracted to another manufacturer, the Contractor shall ensure that the Engineer is authorised to inspect, examine and test the equipment in the premises of the Sub-Contractor.
- 3 These inspections, examinations and tests shall not relieve the Contractor, in any case, from the contractual responsibility and commitments.
- 4 Factory Inspection. The Engineer and his representative shall inspect the Mechanical and Electrical / I&C equipment listed in the tender documents at the manufacturing facilities after the completion of manufacturing process. The Contractor shall notify the Engineer in writing of the Factory Acceptance Test (FAT) schedule dates, 30 calendar days before commencement date of Factory Acceptance Test (FAT) in order that the factory inspection can be arranged. Factory inspections will be made at any reasonable time after the completion of internal testing by the Manufacturer and prior to shipment. Approval of equipment at the factory only allows the manufacturer to ship the equipment to the Site and does not constitute final acceptance. Where specified, the Contractor shall include in the Contract Price for all the costs of the Engineer and his representative. The equipment will be released from the manufacturing facilities only after written FAT witness test reports are accepted in writing by the Engineer/Client.
- 5 Factory Acceptance Witness Tests and Test Certificates. Factory Acceptance Witness tests shall be carried out as specified in the Project Specification at manufacturing facilities places, and as required by international standards and industry norms. Detailed Factory Test Procedures shall be provided by the Contractor and submitted for Engineer's approval minimum 60 days before the proposed inspection date and shall be subject of Engineer's approval. The FAT test procedure shall be approved by the Engineer 30 days before the FAT witness date is proposed.
- 6 The Contractor shall ensure that the manufacturer provides all labour, materials, electricity, fuel, stores, apparatus and all instruments as are requisite and as may reasonably be required to carry out the test efficiently. The Engineer and his representative will witness the FAT tests.
- 7 The Contractor shall submit from the equipment manufacturer, a certified internal written test certificate in accordance with the requirements/international standards of the relevant test procedure before the FAT witness testing date.

- 8 If after examining or testing any equipment the Engineer, or his representative, shall decide that such equipment or any part thereof is defective or, not in accordance with the specification, he may reject the said equipment or part thereof. He shall notify the Contractor in writing within 7 calendar days of the rejection, stating the grounds on which the rejection is based.
- 9 Wherever possible, Site conditions shall be simulated at the manufacturing facilities during FAT witness, or the tests shall be extended to allow for Site conditions. Where the pumps are driven by VFD equipment, the complete Motor VFD shall be FAT witness tested in the presence of the Engineer.
- 10 Should the Contractor provide for tests to be made in the premises of the Contractor or any Sub-Contractors or suppliers, the Contractor shall afford any assistance, labour, materials, electricity, fuel supplies, equipment and instrument required and which can be reasonably requested for these tests.

23.1.2 Inspection and Tests at Site

- 1 This specification defines the tests to be made on electrical equipment, distribution systems and installations at site to establish compliance with the specification and to ensure they are entirely suitable for the intended purposes.
- 2 For all tests a minimum of 30 days notice in writing shall be given by the Contractor to the Engineer to enable the tests to be witnessed.
- 3 All electrical tests, unless otherwise specified, shall be made either in a manner prescribed in the relevant:
 - (a) British Standard Specification and Code of Practice
 - (b) IEE Regulation (latest edition)
 - (c) QGEWC regulation
 - (d) Civil Defence Department regulation
 - (e) or where no Standard/Code/Regulation exists, in a manner approved by the Engineer.
- 4 A pre-closing Inspection shall be carried out on all items of Electrical equipment, cables and conduit to be permanently concealed i.e. underground cables and ducts, conduit in screed or plastered into walls, above ceiling etc.
- 5 The Contractor shall provide the Engineer with 3 clear working days notice of his intention to cover the works. Failure to comply with this requirement shall result in the re-exposure. Engineer's inspection and re-exposure of the works being carried out shall be at the Contractor's expense.
- 6 The inspection and tests specified herein do not supersede but are supplementary and complimentary to the tests called for in Project Specifications and clauses for equipment, systems and installation.

- 7 The Contractor shall supply all necessary instruments, apparatus, consumable stores, connection, skilled and unskilled labours and services with proper, reasonable and safe facilities required for the tests. Any costs which may be involved in the tests shall be included in the tender. The Contractor shall satisfy the Engineer that the instruments and the equipment to be used for any test are adequate as regards accuracy and calibration for the tests to be undertaken.
- 8 Workmanship shall be checked during work in progress and completed work inspections. Any work not to the satisfaction of the Engineer during such inspection shall be replaced to a standard approved by the Engineer at the Contractor's expense, and prior to any subsequent inspection.
- 9 A complete written record shall be made by the Contractor of all inspections and tests. These records shall be made at the time of the tests and shall be countersigned by the Engineer, if present, as a true record. A copy of each record sheet shall be included with the operation and maintenance manual. Inspection or approval of tests, acceptance of test certificate and waiving of tests, by the Engineer, of any equipment, works or installation shall not relieve the Contractor from the obligation to supply the complete equipment and complete work and installations in accordance with the Project Specification and suitable for the purpose intended.
- 10 Certificates of tests shall contain or have attached to them, the following information:-
 - (a) the job name and number as designated by the Engineer
 - (b) the name, address and contract or order number of the Contractor
 - (c) a description of the item, component, equipment, system or installation tested including any fabrication, block or production number
 - (d) date and time of test
 - (e) environmental conditions including weather, if relevant
 - (f) the testing party (if other than the Contractor) and signature of the Engineer
 - (g) the properties to be tested and the source of the parameters for such properties, i.e. British Standard, Codes of Practice, QGEWC (KAHRAMAA) Regulation, Specifications, etc
 - (h) the results of the tests and any divergence from the specification, production drawings or statutory requirements
 - (i) the detail of any works to be completed but which is outside the scope of this test.
- 11 The Engineer shall have discretion to waive inspection/testing for either any part or of the complete installation.

23.2 ELECTRICAL INSTALLATION TESTING

23.2.1 General

- 1 On completion of the entire electrical installation work or any separate or distinct part thereof, notify the Engineer, in writing, that the complete part of the electrical work is ready for inspection and testing. Before doing so, perform initial trial tests. Test, correct, adjust, balance, regulate, etc., the section concerned as necessary until required conditions are obtained.

- 2 The results and readings obtained for tests shall be equal or better than the requirements of the IEE and the QGEWC Regulations and these shall be recorded on Forms similar to the ones described in the IEE Regulations. The tests shall be carried out in a manner as described in these regulations.
- 3 The Contractor shall supply all instruments and tools required for carrying out the tests.
- 4 In case the tests specified below are satisfactory and no errors or faults appear in the installation, submit the necessary test forms, duly filled out, to QGEWC to repeat, if necessary, the tests in the presence of QGEWC inspectors.
- 5 Upon Completion of testing, the Contractor shall follow-up and make all necessary arrangements with the QGEWC and Telecom Provider for the purpose of providing permanent electricity supply and telephone services to the new facilities. Also provide all facilities and attendance to QGEWC for any other tests to be carried out before energising the installation.
- 6 The testing of the installations shall comprise of the following but not limited to:-

23.2.2 Verification of Polarity

- 1 Verification of polarity shall be made to ensure that all fuses and single pole control devices are connected only on the live phase conductor. The neutral must not be connected through any of these devices.
- 2 The centre contact of Edison type screw lamp holder shall be connected to the phase conductor, the outer threaded metal part shall be connected to the neutral conductor.
- 3 Wiring to plugs and socket outlets should be such that they are connected with phase conductor on the right pole when viewed from the front.
- 4 A suitable type of testing device shall be used to confirm the above.

23.2.3 Earth Electrode Resistance

- 1 Upon installation of earth electrode, test shall be carried out to ensure that the installation of electrode has reduced the earth fault impedance effectively to the required value.
- 2 Resistance to earth of all earthing rods, each earth termination network, continuity of conductors and all bends and joints shall be tested by means of a Wenner test. The electrode resistance shall not exceed 1 ohms requirement or as specified in the QGEWC (KAHRAMAA) regulation.

23.2.4 Insulation Resistance

- 1 Insulation resistance test shall be carried out before a completed installation is permanently connected to the supply. Large installations may be divided into groups. A DC voltage not less than twice the normal supply voltage (RMS value of AC system voltage) shall be applied for the measurement of the insulation resistance. For low voltage installations, where apparatus voltage rating does not exceed 55 V, shall be tested applying 500 V DC only.
- 2 When measured with all fuse links in place, all switches (including, if possible, the main switch) closed, the insulation resistance for whole installation shall not be less than 1 meg ohm.

- 3 When measured between one phase conductor and other conductors connected together to earth, in turn for all phases, the insulation resistance shall be not less than 1 mega ohm.
- 4 Wherever possible, so that all parts of the wiring may be tested, all lamps shall be removed, all current using apparatus disconnected, all local switches shall be closed; where removal of lamps or disconnection of current using apparatus is not practicable, respective control switches shall be opened.
- 5 Where apparatus is disconnected for the tests, the insulation between the enclosure or frameworks and all the live parts (phase) of the apparatus shall be measured separately and shall comply with the requirements as per BS for the corresponding apparatus, where such standard is not available, the insulation resistance shall not be less than 0.5 meg ohm.

23.2.5 Ring Circuit Continuity

- 1 A test shall be carried out to verify the continuity of all conductors (including the earth continuity conductor) of every ring circuit and all readings shall be tabulated.

23.2.6 Phase Rotation

- 1 The complete installation shall be tested to ensure that all distribution boards are connected to give correct phase rotation for the corresponding apparatus as required.

23.2.7 Continuity of Protective Conductor

- 1 A test shall be carried out to verify that all protective conductors are connected correctly and are electrically sound, before power supply is connected to an installation.
- 2 When the protective conductor is a core in multi-core cable or a separate protective conductor, a DC ohmmeter may be used to measure the resistance. Where steel conduits or other metallic structure is used as protective conductor, the test shall be carried out by current injection at a voltage not exceeding 50 V AC or DC and current about 1.5 times the normal circuit current but not exceeding 25 Amps. When using DC source, it must be ensured that inductors are not connected in the test path.
- 3 A portable hand generator is preferable to use for this test so that the disconnected phase conductor can be connected to the consumer earth terminal and tests can be made between phase conductor and the protective conductor at each outlet point.

23.2.8 Earth-fault Loop Impedance

- 1 Each completed installation shall be tested for effectiveness of the earthing by means of an earth fault loop impedance test. The test shall be carried out by using earth loop impedance test instrument

23.2.9 Operation Tests

- 1 This clause applies to relays, Interlocks and any other protective and control device, viz., residual current devices, to ensure correct functioning.

- 2 Suitable test pro forma shall be prepared, as per the recommendation of the manufacturer for protective relay tests and submit to the Engineer for approval. Logic diagram for control and interlocks shall be prepared, based on the requirement for functional tests, and shall be submitted to the Engineer for approval. Tests shall be carried out according to the approved form and all results shall be tabulated.
- 3 The RCDs shall be tested by external supply to check for instantaneous operation. The testing device shall be single phase double wound continuously variable type transformer (variac) with maximum output voltage 50 V and loading resistors to control current. While rated current applied, the device shall operate instantaneously or within a time delay as per manufacturer data sheet. The test current to be applied shall be as per manufacturer recommendation.

23.3 ELECTRICAL EQUIPMENT TESTING

23.3.1 General

- 1 The Contractor shall fully test and commission the whole of electrical installation in accordance with QGEWC and IEE regulations, as per requirements of the Project Documentation and as outlined in this section.
- 2 The following equipment will be inspected and tested on site after installation. Any omission or defects, or faults raised by the Engineer are to be remedied or corrected by the Contractor and re-testing made at the direction of the Engineer at the Contractor's expense:
 - (a) 415V switchgears and MCC, VFD
 - (b) Mains cable
 - (c) Motors
 - (d) Starters and control gear
 - (e) Control and starter panels
 - (f) Small wiring etc.
 - (g) Elevator, walkway system
 - (h) Radio and TV interference
 - (i) Fire alarm and detection system
 - (j) Public address system
 - (k) HV switchgear
 - (l) HV cables
 - (m) Power transformer
 - (n) EHV cables
 - (o) Main telephone installations
 - (p) Diesel Generators
- 3 Following functional tests shall be carried out to ensure proper functioning of the plant and all apparatus.
 - (a) All protective circuits, interlocks, control and alarm shall be tested for correct operation
 - (b) All lighting circuits shall be energised and checked to ensure that they are operational

- (c) All motors, plants and electrical equipment connected with mechanical services shall be checked to ensure that they run freely in the correct direction/rotation and in correct sequence
 - (d) Fire alarm system, fire fighting system, SCADA/PLC, etc, elevator system and building management system (if applicable) shall be tested for correct operation.
 - (e) All major authority related testing requirements shall be witnessed by the relevant authority representative (QGEWC, Qatar Civil Defence, or Telecom Provider). The Contractor shall give a minimum of one-week advance notice prior to performing any major tests
 - (f) The Contractor shall obtain all relevant testing requirements from QGEWC and Telecom Provider and make available all necessary testing apparatus.
- 4 The testing requirements and procedures for the various items of electrical equipment is specified in the other relevant specification parts for electrical works and relevant standards.

23.4 COMMISSIONING

23.4.1 General

- 1 This specification deals with the Contractor's work involved in commissioning to energise the electrical distribution systems, installations and plants after inspections and tests to ensure safety and proper operation; and the evaluation of performance by means of further inspection and tests to ensure the works operate in conformity with the design specification.
- 2 Commissioning works shall be carried out by the Contractor using trained, experienced commissioning engineers. The commissioning engineer shall perform switching operations and also must be in charge for the opening and closing of circuits, interlocks and safety devices.
- 3 The Contractor in conjunction with the Engineer shall prepare a commissioning schedule. This shall show a time scale and the extent of power or other services requirements for setting the plant to work. The following information shall be made available to the Engineer:
 - (a) Specification of work
 - (b) Test certificates from works test at manufacturers facilities
 - (c) Test results from site progress tests.
 - (d) Notes from pre-commissioning meetings.
- 4 The method statement shall be submitted to the Engineer and get it approved at least 1 month before the commencement of commissioning tests.
- 5 After commissioning, the plant shall operate for the guarantee period as per the requirements of the Project Documentation, from the date of practical completion certificate issue in accordance with normal requirements without defect of any kind. Any defect which appears shall be remedied forthwith by the Contractor without any cost to the contract and reliability run shall start after re-commissioning. The guarantee period shall be calculated from the latest date of such re-commissioning.

END OF PART