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1 GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

1.1 GENERAL

1.1.1 Scope

- 1 The purpose of QCS is to provide as a general technical guide for acceptable construction work practices in the State of Qatar, considering this; any addition for technology, material, specification, standard that are not mentioned in this section or their modification, shall be subject to approval as stated in the introduction of QCS (00-02).
- 2 All regulations and requirements shall comply with the latest compulsory regulations or requirements issued by Qatar General Electricity & Water Corporation (KAHRAMAA).
- 3 The Electrical Installation Contractor, herein referred to as the 'Contractor' within this part and all other Section 21 parts of this specifications shall carry out all electrical works complete in accordance with the requirements of the Project Documentation.
- 4 The scope of work shall include but not be limited to:
 - (a) The supply and installation of all services, equipment, components, accessories, and fittings required for the operation of the facility to the extent specified and detailed on the Drawings and Specifications including 400 days maintenance or as stipulated in the contract specification and all extended warranties after provisional handover.
 - (b) Builder's work in connection with the Electrical Installations, including supply, necessary inserts sleeves and making good.
 - (c) Any work which can be reasonably inferred as necessary for the safe, satisfactory operation of each system, whether such work is specified or shown on drawings or not
 - (d) The supply and installation of cables, conduits, boxes and termination points, for the motors, starters, controls and the like for the Process Equipment, Heating, Ventilation and Air-conditioning and Plumbing services
 - (e) (Arranging for installation of permanent Electrical supply by the Qatar General Electricity and Water Corporation (KAHRAMAA), including submission of all necessary documents to the KAHRAMAA, and carrying all necessary approvals and obtaining consumption meters Moreover, the Contractor shall allow in his tender and be responsible for the payment of all charges by way of examination, certification, depositing or connection fee to any Statutory Authority. (I.e., Electricity, Water, Drainage, Telephone, Fire, etc).
 - (f) Supply and installation of permanent electrical supply equipment and cables in compliance with KAHRAMAA requirements and approvals. The electrical equipment is required for the implementation of the new facilities as well for the supply of new loads, The supply includes EHV cables, HV/MV substations, HV and MV cables and accessories, consumption meters, and all related civil works, and including submission of all necessary documents to KAHRAMAA, and carrying all necessary approvals.
 - (g) Coordinating with KAHRAMAA regarding outage schedule, attending upon the Supply Authority installing mains power supply and carrying out primary and secondary injection tests and any other tests as directed by KAHRAMAA.
 - (h) Arranging and carrying out all necessary approvals with the Licensed Telecom Service Provider for the Telephone System.
 - (i) Arranging and carrying out all necessary approvals with the Qatar Civil Defence Department for the Fire Alarm System, extinguishing and protection systems.
- 5 For voltages and frequencies, regulations and requirements of Kahramaa and relevant authorities should be taken into account.

1.1.2 **Regulations**

- 1 All supplies and services offered in response to this specification shall conform to the latest standards.
- 2 The design, equipment and installation requirements shall comply with the standards and recommendations laid down by the following:
 - (a) Regulations for Electrical Installations as issued by the Qatar General Electricity and Water Corporation (KAHRAMAA) Qatar
 - (b) Regulations for Electrical Installations as issued by the Institution of Electrical Engineers (I.E.E.), London (for points not included in KAHRAMAA Regulations)
 - (c) Recommendations for Lighting Installations as issued by KAHRAMAA and the Chartered Institute of Building Services, London
 - (d) Standards relating to Electrical Installations and equipment as issued by International Electrotechnical Commission (I.E.C.) and British Standards Institute (BSI)
 - (e) Regulations for telephone system installation as issued by the Licensed Telecom Service Provider.
 - (f) National Electrical Code issued by National Fire Protection Association (NFPA), Boston, U.S.A.
 - (g) Rules of the Qatar Civil Defence Department for Fire Alarm Installations.
- 3 Where two or more applicable standards and/or the Specifications are in conflict, the most stringent shall apply.

1.1.3 **Existing Services**

- 1 The Contractor is deemed to have visited and inspected the site to familiarise himself with the existing site conditions and services at tender stage.
- 2 The approved Contractor shall obtain the existing services record drawings from KAHRAMAA and various utility services departments (i.e Licensed Telecom service providers, CDD etc).
- 3 Co-ordination between shop drawings, work on site and existing services shall be carried out by the Contractor.
- 4 The Contractor shall be fully responsible for any damages to the existing services including repairs, and penalties imposed by the concerned parties etc and for removing any site obstacles such as underground cables, pipes, civil works etc. which is obstructing his work on site.
- 5 The approved contractor shall also be responsible for liaison with KAHRAMAA, Licensed Telecom Service Providers and all other government utility departments to disconnect or divert the existing services supply to the existing site prior to demolishing.

1.1.4 **KAHRAMAA Contract Drawings**

- 1 The indication and/or description in any of the Contracts documents, unless otherwise specifically stated, implies an instruction to supply and fix such items.
- 2 Notes on Drawings referring to individual items of work take precedence over the Specification.

- 3 Drawings show the general run of cables, raceways, etc. and the approximate location of equipment and utilities; symbols and schematic diagrams are of no dimensional significance. Obtain from the Engineer dimensions not shown on, or which cannot be determined from Drawings. Do not scale drawings to obtain locations.
- 4 Notify the Engineer of conflicting requirements. Where departures from the drawings are deemed necessary, details of such departure and reasons thereupon shall be submitted to the Engineer for approval.
- 5 No such departure shall be made without prior written approval of the Engineer.
- 6 The design specifications and criteria shall not relieve the Contractor from continuously following up with the respective authorities to obtain up-to-date requirements and instructions.

1.1.5 Shop Drawings

- 1 The term 'shop drawings' includes fabrication, erection, layout and setting out drawings; manufacturer's standard drawings, schedules; descriptive literature, illustrations, catalogues and brochures; performance and test data; wiring and control diagrams and other drawings and descriptive data pertaining to materials, equipment, raceway systems, control systems and methods of construction as required to show that materials, equipment and systems and position thereof, conform to the Contract Documents. The term 'manufactured' applies to standard units usually mass produced. The term 'fabricated' means items specifically assembled or made out of selected materials to meet individual design requirements.
- 2 Shop drawings shall establish actual detail of all manufactured or fabricated items, indicate proper relation to adjoining work, amplify design details of electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions.
- 3 The Contractor shall submit for approval and obtain in due time to conform to the Contract Program, all shop and installation drawings based on the design drawings approved by the KAHARAMAA and all other relevant Municipality and Government Authorities.
- 4 The Contractor, immediately after being awarded the said Contract, shall prepare and submit shop drawings. Shop drawings shall be submitted with such promptness as to cause no delay in his own work nor to any other Contractor. No extensions of time will be granted because of failure to have shop drawings submitted in ample time to allow for processing, in accordance with the submittals schedule outlined in Section 9, Part 1, Clause 1.1.4.
- 5 Provide shop drawings, to a scale not smaller than the corresponding layout drawings, showing the following and obtain approval before commencing work:
 - (a) exact runs and sizes of conduits, ducts, cables, cable trays and trunking
 - (b) layout drawings for each separate electrical installation showing the actual locations of points, suitably identified, the locations of switchgears, switchboards, motor control centres and distribution boards, details and types of fittings.
 - (c) plans showing the equipment assembly, space requirements, clearances and locations for cable entrances and anchor bolts.
 - (d) elevations showing all parts, devices, components and nameplates, positions and arrangements of the equipment. Show as many elevations as necessary to clearly depict component and device arrangements.
 - (e) schedules of points, indicating how the various outlets are connected to the distribution boards, size of circuit wiring, the rating of the protective device and the type and size of appliance of fitting.

- (f) schematic diagram of connections of distribution boards, and equipment to main switchboards showing sizes of feeders, etc
 - (g) schematic and elementary wiring diagrams, of each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices
 - (h) connection wiring diagrams, of each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices
 - (i) complete catalogue information of all parts and components of electrical equipment
 - (j) all cable routings and layouts for the different electrical services, feeders and branch circuits showing routes, sizes and types of cables
 - (k) any other data necessary for the proper maintenance of the installations.
- 6 Drawings shall be ISO standard size A1. Lettering shall be stencilled. Shop drawings and samples shall be properly identified with the name of the Project, the Contractor, the Sub-Contractor and the date, and signed by Contractors Authorised Engineers.
- 7 Final co-ordination of electrical works with mechanical, structural and architectural work shall be carried out from complete shop drawings and sufficient time shall be allowed for co-ordination and checking of shop drawings and calculations after shop drawings are submitted.
- 8 Individual shop drawings shall be submitted following the distribution of the co-ordination drawings and shall bear a stamp indicating that the work has been co-ordinated with other trades.
- 9 The Engineer's review and approval of shop drawings submitted by and approved by the Contractor is for general conformance with the design concept and information given in the Contract Documents and shall not relieve the Contractor from responsibility for any deviations from the requirements of the Contract Documents. The Engineer's review and approval shall not be construed as a complete check nor shall it relieve the Contractor from responsibility for error of any sort in shop drawings or schedules, or from the necessity of furnishing any work required by the Contract Documents which may have been omitted on the shop drawings. The Engineer's review and approval of a component item shall not indicate review and approval of the complete assembly in which it functions.
- 10 The Engineer or the supervising consultant shall forward electrical drawings and specifications which are to be submitted for approval to KAHRAMAA, when appropriate. However, it shall be the Contractors responsibility to obtain written approval from KAHRAMAA for all such drawings and specifications appertaining to the work carried out under the contract. KAHRAMAA approvals may take a considerable time to obtain and the Contractor should make allowance for this and be available for liaising with and pursuing approvals with KAHRAMAA.

1.1.6 Progress Drawings

- 1 Provide and keep on the job at all times, one complete and separate set of blackline prints of the electrical work on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all architectural and electrical changes, revisions and additions to the work. Whatever work is installed otherwise than as shown on the Contract Drawings, such changes shall be noted.
- 2 Indicate daily progress on these prints by colouring in the various conduit, ducts, trunking, cable trays, fixtures, apparatus and associated installation works erected.

1.1.7 As built drawings

- 1 The Contractor shall provide the as built drawings, as approved by the Engineer, in DXF format or AutoCAD DWG format, either in floppy diskettes or in CD-ROM, as per the Project Documentation requirement. The drawings shall be submitted not later than 2 months after completion of the Project, or putting into operation, whichever is earlier. An addition, 3 sets of hard copy of all relevant drawings, which will be required for operation and maintenance, shall be supplied in bound book forms immediately after the commissioning of the Project. The quality of these drawings shall be consistent with the standard of KAHARAMAA. Diary sheets for Work completed shall not be authorised until such records have been presented to the Engineer and accepted.
- 2 The Contractor shall supply, 3 sets of all operation and maintenance manuals in original, from the manufacturer in bound book forms, at least 2 weeks prior to commissioning of the equipment. These shall also be supplied, in computer diskettes, based on popular Microsoft window based publishing software programmes, along with the as built drawings as mentioned above, as specified in the Project Documentation or as directed by the Engineer.

1.1.8 Builders Work

- 1 Lay electrical works in advance of pouring concrete slabs and construction of walls. Obtain Engineer's approval before commencing builder's work in connection with electrical installation. Related co-ordinated shop-drawings shall be submitted for approval as per the related clause 1.1.5 of this section. Materials approval shall be obtained as per procedure detailed in clause 1.1.9 below. The Contractor shall make it certain that drawings properly co-ordinated with other works are submitted immediately after signing of the contract and approval of drawings and the materials are obtained at least one month prior to the commencement date of the construction.
- 2 Check with other trades to ensure equipment and material can be installed in space provided.
- 3 Provide other trades with information necessary for them to execute their work.
- 4 Details on drawings which are specific regarding dimensions and locations, are for information purposes. Co-ordinate with other trades to ensure work can be installed as indicated.

1.1.9 Programme

- 1 The Contractor shall produce a work programme based on CPM or Bar-chart form or as directed by the Engineer indicating the time required for various operations to complete the Project in time. The following points shall be highlighted in the programme:
 - (a) mobilisation
 - (b) drawings/submittals
 - (c) approvals
 - (d) equipment deliveries including delivery periods from supply sources external to the State of Qatar
 - (e) first fix
 - (f) cabling
 - (g) main/sub-main distribution equipment
 - (h) second fix
 - (i) fixing of light fittings
 - (j) testing

- (k) commissioning and handing over.
- 2 The Contractor is responsible for all liaison with KAHARAMAA in respect of programming the installation and commissioning of complete electrical system. The Contractor shall ensure that KAHARAMAA are at all times kept informed of the current progress of the electrical works on site and that his approved electricity supply subcontractor programs the cable laying works in the specified sequence in accordance with the approved programme.

1.1.10 Equipment and Materials Approval

- 1 Approval of materials and equipment shall be based on latest manufacturer's published data.
- 2 Complete and detailed information of all materials and equipment to be incorporated in the work shall be submitted. Submit detailed description and specifications, catalogues cuts, installation data, diagrams, dimensions, controls and any other data required to demonstrate compliance with the Contract Documents. Each item submitted shall be referenced to the applicable paragraph in the Specification.
- 3 At the request of the Engineer, submit a sample of any equipment or material for further study before approval. Where samples are required by the Engineer, the period required to obtain the sample will be taken into account when scheduling approvals.
- 4 Only approved materials shall be employed at the site. All materials installed which are not approved shall be removed and reinstated by approved ones.
- 5 Time periods for equipment and materials approvals shall be as outlined in Section 9, Part 1, Clause 1.1.4.

1.1.11 Fire and Safety Precautions

- 1 Establish from Architectural Drawings where fire and smoke barriers exist and make adequate provision of fire and smoke barriers in and around trunking, conduits, cables, etc., where they pass through floors and fire rated walls, and where protection systems are installed pack space between wiring and sleeve full with Fire Retardant Material and seal with caulking.
- 2 The Contractor shall ensure that this work is carried out such that the integrity of any such fire barrier is properly maintained where pierced by electrical services.
- 3 For each switchboard the Contractor shall supply the following equipment:
- (a) 1 no. electrical grade rubber mat to BS 921 1000 mm wide extending the full length of the switchboard
 - (b) 1 no. pair of electrical grade rubber gloves to BS 697. The hand glove should have the date of test stamped on it.
 - (c) 1 no. notice in English and Arabic advising treatment for a person suffering from electrical shock.
- 4 The Contractor shall put the notice for electrical shock treatment in details with sketches and instructions as per standard procedures. The notice shall comply with the requirement of the KAHARAMAA in content and format. However, this should include the following as a minimum,
- (a) **ACT IMMEDIATELY**
- (i) Safeguard Yourself
 - (ii) Switch off current or break electric circuit
 - (iii) Use or stand on some dry non-conducting material to remove the CASUALTY from cable or source of electricity.

- (iv) Start artificial respiration and call for Medical Aid

(b) TREATMENT FOR ELECTRIC SHOCK

ARTIFICIAL RESPIRATION

(KISS OF LIFE, MOUTH TO MOUTH METHOD)

- (i) Lay the casualty on back and if possible on a table
- (ii) Kneel or stand near to the casualty's head
- (iii) Remove any obstruction from the mouth
- (iv) Support the nape of the neck and press top of the head so that it is tilted backwards
- (v) Open your mouth and take a deep breath, pinch the casualty's nostrils with your fingers. Seal your lips round his mouth and blow into his lungs until the chest rises.
- (vi) Remove your mouth and watch the chest falls
- (vii) Repeat and continue inflation at your natural rate of breathing. Continue to give artificial respiration until natural breathing is restored or until the medical aid arrives
- (viii) When the casualty is breathing, place in recovery position, lying and resting on the side. Remain with and watch casualty closely.

1.1.12 Protection

- 1 The Contractor shall be responsible for his work and equipment until finally inspected, tested, accepted and handed over. Materials and equipment which are not immediately installed after delivery to site shall be stored carefully. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.
- 2 Protect work and material of other trades from damage that might be caused by his work or workmen and make good damage thus caused.
- 3 Protect exposed live equipment during construction for personnel safety.
- 4 Shield and mark live parts "LIVE 240 VOLTS" or with appropriate voltage in English and Arabic.
- 5 Arrange for installation of temporary doors for room containing electrical distribution equipment. Keep these doors locked except when under direct supervision of an electrician.

1.1.13 Quality of Staff/Personnel

- 1 The electrical services installation shall be carried out in a professional manner by experienced and qualified personnel.
- 2 Electrical Contractor shall be to the classifications required by KAHARAMAA and shall carry a valid licence.
- 3 Prior to the commencement of works the Contractor shall notify the Engineer of his intended site staffing levels.
- 4 The Contractor shall appoint one graduate Electrical Engineer full time with 5 years' experience in similar works and qualified staff/personnel for the supervision of the Electrical Installation Works.
- 5 The name, qualifications and experience of the nominated engineers shall be submitted to the Engineer for approval within 15 days of the receipt of the order to commence the works.

- 6 An Electrical Foreman of 10 years' experience in similar projects should be full time available on site for direct follow up and implementation of the electrical works.
- 7 Qualified and Experienced Electricians shall be available on site to carry out the works in accordance with the programme.
- 8 The Engineer reserves the right to require the Contractor to provide information and documentation as may be necessary to establish the validity of any individual persons proficiency and effect their removal from site should they prove to be unsatisfactory.

1.1.14 Climatic Conditions

- 1 The climate in Qatar in the summer months is hot and humid and a humidity of 100 % at 30 °C has been recorded.
 - (a) violent sand and dust storms of several hours' duration occur and even on comparatively still days, fine dust is carried in suspension in the atmosphere.
 - (b) all apparatus and equipment shall, therefore, be so designed and constructed that they operate satisfactorily and without any deleterious effect for prolonged and continuous periods in the conditions stated above and at the following ambient temperature conditions:
 - (i) maximum sun radiation temperature in summer - 84 °C
 - (ii) maximum ambient temperature in summer - 52 °C
 - (iii) average max. ambient temperature in summer - 45 °C
 - (iv) minimum ambient temperature in winter - 0 °C
 - (v) the altitude of Qatar may be taken as sea level.
- 2 The temperatures quoted above make no allowance for heat generated from equipment itself or from any other equipment in the vicinity.
- 3 The capacity and ratings of all electrical equipment and materials given are, unless otherwise indicated, for Qatar climatic conditions. Provide the basis of the derating factors applied in each case
- 4 Where specific sizes are indicated e.g., cable sizes, due allowances have been made in the design for the climatic conditions of Qatar and derating has been applied
- 5 Where no ratings or sizes are indicated for components and other accessories, supply equipment which will give trouble free service in the ambient conditions stated above.

1.1.15 Samples

- 1 The term 'samples' includes natural materials, fabricated items, equipment, devices, appliances, or parts thereof as specified and other samples as may be required to determine whether kind, quality, construction, workmanship, finish, colour and other characteristics of materials conform to requirements of the Contract Documents.
- 2 Samples shall establish kind, quality and other required characteristics of various parts of the work. Indicate details of construction, dimensions, capacities, weights and electrical performance characteristic of equipment or material.
- 3 Samples and sample board should be prepared and identified by the manufacturer and stamped/engraved with make, type, Cat No. and size marking should be indelible and legible.

1.1.16 Quality of Materials

- 1 Manufacturers shall provide their standard guarantees for products furnished under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have by law or by other provisions of the Contract Documents.
- 2 All materials, items of equipment and workmanship furnished under this Contract shall carry standard warranty against all defects in materials and workmanship. Any faults due to defective or improper material, equipment, workmanship or Contractor's design which develop shall be made good, forthwith, by and at the expense of the Contractor, including all other damage done to areas, materials and other systems resulting from this failure.
- 3 Guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- 4 Upon receipt of notice from the Engineer, of failure of any part of system or equipment during the period of maintenance, the affected parts shall be replaced.

1.1.17 Equipment Duties and Ratings

- 1 Power ratings shown for the proposed equipment are in accordance with the best information available to the Engineer and are to be considered as minimum ratings. In the event equipment items proposed by the Contractor should require motors with different power rating than shown, it shall be the Contractor's responsibility to furnish circuit breaker, starting equipment, feeder and branch circuits, conduits, and accessories etc. as required to comply with the electrical code and prevent excessive voltage drop without added cost to the Client.
- 2 Where equipment to be furnished is installed in an existing enclosure or adjacent to existing equipment, the Contractor shall field check the dimensions of existing equipment, location of conduits, etc., and shall familiarise himself with all existing conditions and difficulties to be encountered in performing such work.
- 3 Degree of protection for all electrical equipment shall be as follows:
 - IP 54, for indoor equipment
 - IP 55, for outdoor equipment
 - IP 68, for submersible equipment
- 4 All external equipment to be of metallic construction.
- 5 The equipment shall be located generally as indicated on the drawings and the Contractor shall ensure that the equipment is suitably constructed to permit installation as shown. The equipment shall where necessary be constructed in modular form to permit access into the buildings and facilitate ease of erection at site.
- 6 The equipment arrangements and single line diagram are for guidance only and show a practical arrangement that would be acceptable. The Contractor may propose an alternative arrangement which meets the requirements of the specification.
- 7 All equipment performing similar duties shall be of a single type and make and be fully interchangeable in order to limit the stock of spare parts required. This is to apply particularly to such items as motors, switchgear, instruments, controls, relays, etc.

1.1.18 Workmanship

- 1 The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner. The Contractor shall provide the system in accordance with the best trade practice and to the satisfaction of the Engineer.

- 2 Keep others fully informed as to the shape, size and position of all openings required for apparatus and give full information sufficiently in advance of the work so that all openings may be built in advance. Provide and install all sleeves, supports, etc., hereinafter specified or required.
- 3 Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from others which may be necessary to facilitate work and the completion of the whole Project.
- 4 Provide the services of an experienced foreman, who shall be continuously in charge of the erection of the electrical work, together with all necessary skilled workmen, helpers and labourers, required to properly unload, transfer, erect and connect up, adjust, start, operate and test the system.
- 5 Before installing any work, verify that it does not interfere with clearance required for other work. Notice of adverse conditions shall be forwarded in writing to the Engineer before any work in question is installed. If notification is not made, and work installed causes interference with the contemplated design, make such changes in his work as directed by the Engineer to permit the installation of all work of the Project, at no additional cost to the Client.
- 6 Raceways shall be run as straight and direct as possible in general forming right angles with or parallel with walls or piping and neatly spaced, with risers erected plumb and true, maintain a clearance of at least 25 mm between finished coverings and adjoining work. Approved ceiling height shall be obtained from Architectural Drawings.
- 7 All equipment and accessories shall operate without objectionable noise or vibration. Should operation of any of the equipment or systems produce noise or vibration which is, in the opinion of the Engineer objectionable, make change in equipment and do all work necessary to eliminate the objectionable noise or vibration at no additional cost to the Client.
- 8 Wherever possible services shall not cross expansion joints. Where this is unavoidable the services shall accommodate the design movement without damage, by use of approved expansion couplings/flexible conduit arrangement.
- 9 All MV, HV and EHV works shall be carried out by a contractor or sub-contractor pre-qualified and approved by KAHARAMAA. Proof of such approval shall be required in writing prior to the works commencing on site and the name of any sub-contractor to be used shall be entered in the relevant form of tender when the tender is submitted. All cable jointers to be used on the Contract shall be required to undertake and pass a trade test conducted by KAHARAMAA at the Contractor's expense.

1.1.19 Labels/Circuit Lists/Cable Identification

- 1 For substations, switchgears, switchboards, motor control centres and panel boards:
 - (a) engraved lamacoid name plates, black with minimum 10 mm high white lettering.
- 2 For Distribution Boards and Circuit Breakers:
 - (a) where individually enclosed or in substations, switchgears, switchboards, motor control centres and panel boards without doors : engraved lamacoid nameplates, black with minimum 8 mm high white lettering.
 - (b) in panel boards with doors : directories mounted inside transparent plastic covers in metal frames.
- 3 Wiring Identification:

- (a) identify wiring with permanent indelible, identifying markings, either numbered or coloured, heat shrinkable tube or ferrules, on both ends of phase conductors of feeders and branch circuit wiring.
- (b) maintain phase sequence and colour coding throughout
- (c) colour code to standards above as specified elsewhere
- (d) use colour coded wires in communication cables, matched throughout system.

4 Conduit and Cable Identification:

- (a) colour code conduits and metallic sheathed cables
- (b) code with plastic sleeve or paint end points where conduit or cable enters wall, ceiling or floor and also at 15 m intervals along its length.
- (c) colours to be 25 mm wide prime colour and 20 mm wide auxiliary colour to standards above
- (d) number code, per Circuit Schedule, all feeder and branch circuit cables at both connection points and in manholes, handholes, pull-boxes and junction boxes with fibre or non-ferrous metal tags, fastened with non-ferrous wire.

5 Device Plates:

- (a) for Device Plates of local toggle switches, toggle switch type motor starters, pilot lights and the like, whose junction is not readily apparent : plates to be engraved with 3 mm high letters describing equipment controlled or indicated.

6 For Busbars:

- (a) phase identification letters shall be stamped into the metal of the busbars of each phase of the main buses in each substation, switchgear, switchboards, motor control centre and panel board in addition to colour identification
- (b) Letters shall be visible without disassembling current carrying supporting elements.
- (c) busbars shall be sleeved for phase identification by using high temperature grade heat shrinkable coloured PVC sleeving throughout its length. In no circumstances will any kind of wrapping tape be accepted on busbars.

7 For Doors:

- (a) where switchboard rooms, cable chambers, metal screened spaces and the like contain electric power cables, bus bars or equipment operating at voltages exceeding 600 V : enamelled sheet metal, red on white, reading "Danger - High Voltage".

8 For Rooms:

- (a) to switchboard rooms, electric closets, metal screened spaces assigned to electrical equipment, and the like : enamelled sheet metal, red on white, reading "Electrical Equipment Room - No Storage Permitted".

9 Languages:

- (a) nameplates with directional, operational or warning labels shall be in Arabic and English.

1.1.20 Segregation of Services

1 Electrical services shall be segregated as specified throughout the installation to obviate the following;

- (a) electrical interference from one circuit to another
- (b) a fault on one circuit affecting another

- (c) unnecessary fire damage
 - (d) difficulties in circuit identification
 - (e) voltage limits for general safety
 - (f) difficulties in removal and/or maintenance.
- 2 All raceways shall be kept clear of other services except where intentionally earthed or bonded. Generally, raceways shall be kept 150 mm away from and above hot water and 75 mm away from other services.
- 3 Unless specifically indicated otherwise, normal, emergency, low voltage cables and wiring shall be segregated throughout the installation generally in the following manner:
- (a) armoured and sheathed cables: Where more than one tray has been specified or is necessary to accommodate the number of cables on a run, where practical, segregation shall be achieved by dedicating each tray to either normal or emergency services. Where normal and emergency cables have to run together in trays, ducts or trenches, they shall be formed in two groups, one normal and one emergency
 - (b) insulated conductors: Insulated conductor circuits shall, where possible, be segregated throughout by enclosing in separate conduits, trunking or trunking compartments.
- 4 Fire Alarms:
- (a) fire alarm cables shall be segregated from other services throughout and be either armoured and sheathed cable, or insulated conductors enclosed in conduit or trunking, as indicated on the drawings.
- 1.1.21 Electricity Supply**
- 1 The Supply Authority will make available, at the incoming terminals of each Main Switchboard (Medium Voltage Panel) a 3 phase + Neutral, 4 wire, 415 V, 50 Hz supply of adequate capacity and having the following tolerances:
- (a) voltage $415 \pm$ the tolerance shall be $\pm 5\%$ instead of $\pm 6\%$
 - (b) frequency $50Hz \pm 0.1$ Hz (short term ± 0.15 Hz for a duration of only a few seconds)
- 2 Phase rotation of supply to BS 158.
- 3 Neutral: Solidly earthed at transformer location
- 4 Earthing system: TNS
- 5 Obtain fault level and fault duration time from the Supply Authority (KAHRAMAA).
- 6 Obtain confirmation from the Supply Authority of the size and number of cables they will provide to Main Switchboards. Allow for adequate and appropriate cable glands, lugs and boxes.
- 7 After inspection and approval of the Contractor's installation, KAHRAMAA will permit energisation of the feeder cables to the installation.
- 8 KAHRAMAA will only inspect the Contractor's installation and permit energisation of the power supply after receiving a written request to do so from the Contractor.
- 9 The Contractor will be responsible for any delay caused by omission to make the request in good time.

- 10 The Contractor shall provide a generator of adequate capacity to carry out all pre-commissioning tests. Per-commissioning tests may be carried out using mains electricity if this is available.

1.1.22 Polarity

- 1 The polarity of all apparatus used for the Works specified shall be arranged as follows when apparatus is viewed from the front:
- (a) for two pole apparatus the phase or "live" pole at the top (or left hand side) and the "neutral or earthed" pole at the bottom (or right hand side). On plug and socket outlets the polarity shall conform to BS 196, BS 546, or BS 1363 as appropriate
 - (b) for three or four pole apparatus the phases in order red, yellow, blue and neutral reading from top to bottom or left to right in the case of vertical and horizontal layouts respectively.
- 2 All cables shall be so connected between main switchboards, distribution boards, plant and accessories so that the correct sequence of phase colours is preserved throughout the system.
- 3 All cable cores shall be identified with phase colours. Where more than one phase is incorporated on a common system in one room then the live cores shall be red, yellow, blue, as appropriate, and fittings and switch accessories shall be permanently labelled and segregated in accordance with I.E.E. Regulations.

1.1.23 Safety Interlocks

- 1 A complete system of interlocks and safety devices shall be provided as necessary for the safe and continuous operation of the plant in order to provide for the following:
- (a) safety of personnel engaged on operation and maintenance of the plant
 - (b) correct sequence of operation of the plant during start up and shut down
 - (c) safety of the plant when operating under normal or emergency conditions.
- 2 Interlocks shall be preventive and not corrective
- 3 The Contractor shall be responsible for the preparation of interlocking schemes for the approval of the Engineer.
- 4 Locks for interlocking purposes shall be of the figure lock type.
- 5 No spare or master key shall be provided, unless specified.
- 6 Device items are to be arranged to ensure that there is no danger of interchange with existing locks on other units.

1.1.24 Spare Parts

- 1 General:
- (a) provide sufficient spare parts for all the electrical items included within the scope of works. Submit to the Engineer a list of all spare parts to be required for a further two years operation from the date of issue of the Maintenance Certificate
 - (b) spare parts required include but not necessarily limited to those listed below, provided specified in the Project Documentation or where quantities for each item or equipment is recommended by the manufacturer
 - (c) spare parts to be delivered to central stores.
- 2 Main Low Tension Boards:

- (a) 2 % spare moulded case circuit breakers of all different frame sizes, but in any case not less than 2 nos. circuit breaker of each size
- (b) 5 % spare indicating lamps for each indicating lamp in the switchgear
- (c) one set of tools required for switchgear maintenance
- (d) provide complete spare parts as recommended by the manufacturer for different sizes of ACB.

3 Switchboards, Motor Control Centres and Distribution Boards:

- (a) 5 % spare combination magnetic motor starters
- (b) 5 % spare circuit breakers for each rating of each MCCB
- (c) 5 % spare HRC fuses for each rating
- (d) 5 % spare of load break switch (isolators) of each size
- (e) 5 % spare of current operated ELCB of each size

4 Disconnecting Switches:

- (a) 5 % spare switch of each size.

5 Circuit Accessories:

- (a) plug fuses - furnish ten percent (10%) of the number of each size and type of fuses installed, but in any case not less than six fuses of each sizes
- (b) wall switches - provide five percent (5%) of the number of each size and type of wall switch installed
- (c) socket outlets - provide five percent (5%) of the number of each size and type installed
- (d) lamps - provide five percent (5%) lamps of each size and type for indicating panels and pilot lights installed for different systems.

6 Lighting Fixtures:

- (a) for lighting fixtures provide the following spare parts:
 - (i) 2 % of the total quantity of each type of lighting fixture. This quantity shall not be less than one fixture of each type
 - (ii) additional diffusers for 5 % of the total quantity of each type of lighting fixture provided with acrylic, plastic or glass enclosures. Diffusers shall be identical to those of the installed fixtures. This quantity shall not be less than two diffusers of each type
 - (iii) 10 % spare lamps of each wattage of different type
 - (iv) 5 % of the total quantity of control gear (ballast) of each type and size but in no case less than (6) ballast of each size and type.

7 Emergency Generating Sets:

- (a) complete itemised list of different spares to be included and priced by the tenderers. For emergency generator, furnish by the generator supplier to maintain it for two years.

8 The tenderer shall submit with his offer detail prices of the spare parts he is required to provide under the Contract indicating the quantity and the unit rate of each item.

1.1.25 Protection of Excavation

- 1 The Contractor shall comply with all requirements of the Police Department for marking, lighting and protecting excavations. It is the responsibility of the Contractor to ascertain the requirements of Police Department and to comply fully with these requirements. No additional payments will be authorised under any circumstances for marking, lighting or protecting excavations.
- 2 Where carriageway works and road crossings are performed the Contractor shall provide steel plates of sufficient size and quality to permit the safe passage of traffic and the plate shall be so placed (if necessary fixed) to permit reasonable traffic flow.
- 3 All doorways, gates and entrances shall be kept clear with full access. Where excavations impede pedestrian access, crossings boards shall be provided. Crossing boards shall be 1250mm wide with a hand rail on both sides 1 metre high and guard rails on both sides at vehicular access to premises etc. Ducts will not be installed at entrances to premises unless instructed by the Engineer.
- 4 Materials excavated shall be placed so as to prevent nuisance or damage. Where this is not possible, the material shall be removed from site and returned for backfilling on completion of cable laying at the Contractor's expense. In cases where the excavated material is not to be used for backfilling trenches it must be removed from site on the same day as it is excavated. Surplus material shall only be disposed of at Government approved sites. At the time of Contract award the Contractor shall contact the Ministry of Municipality to ascertain the approved sites and route.

1.1.26 Supply of materials

- 1 Where materials are to be supplied by the Contractor, the following shall apply:
 - (a) Materials shall be ordered in accordance with the Specifications issued by KAHRAMAA.
 - (b) Specifications and details of the proposed supplier shall be submitted to KAHRAMAA before a firm order being placed.
 - (c) On delivery of materials from outside of Qatar, KAHRAMAA inspectors shall be given the opportunity to inspect the materials prior to their use.

1.1.27 Special Requirements

- 1 The Contractor shall consult the public utility authorities not less than one month before it is proposed to commence work to ascertain whether any underground installations will be affected by the proposed work, in which event the Contractor shall make all necessary arrangements with the public utility authorities to safeguard the installation.
- 2 The Contractor shall give at least one week's notice in writing to the public utility authorities of the dates upon which it is intended to operate plant or equipment or carry out any work for which permission has been given in writing by the public utility authorities: such operations of work shall only be carried out in the presence of the public utility authorities unless notice has been obtained in writing from the public utility authorities that they do not require to be present.
- 3 The public utility authorities may require work to be executed on their installation during the period of the Contract: the Contractor shall afford all facilities to the public utility authorities' contractors or workmen until their diversion work is complete. The Contractor shall co ordinate the work of the public utility authorities and his own activities and when necessary shall amend his programme of working to suit all requirements of the department in connection with their diversion work and shall keep the Engineer informed of all arrangements made.

- 4 The Contractor shall locate and mark with suitable posts all the public utility authorities underground installations that are within the area of the Works and shall ensure that such markers are maintained in their correct positions at all times; the Contractor shall advise the public utility authorities of any installation not found where shown on the Drawings, or found but not shown or found damaged or subsequently damaged.

END OF PART

ARAB ENGINEERING BUREAU