SECTION 3.2.1

GENERAL TECHNICAL REQUIREMENTS

CONTENT PAGE

Change Log

Rev	Clause	Changes
4 (Nov-2019)	1.1 & 2	General Descriptions
	3.2	QCS issue (2014)
	3.7.1	Number of required copies
	3.10.1.9	Number of required copies
	3.10.1.10	Number of required copies
	3.10.2.1	Number of required copies
	3.10.3.2	Number of required copies
	3.11.1	Number of required copies
	3.11.4.a	Number of required copies
	5.5	IP requirements, gland plate bonding & IEC std. update
	5.9	IP requirements

1. GENERAL PROJECT INFORMATION

The Qatar General Electricity and Water Corporation (KAHRAMAA) is implementing a programme of development to meet increasing demands for electricity. As part of this programme, KAHRAMAA wishes to enhance the power transmission facilities by expanding the existing transmission system.

1.1 Qatar Transmission System

The Qatar transmission system (QTS) is composed of underground cable and overhead line networks operated at 400 kV, 220kV, 132kV, 66kV and 33kV. The distribution system is operated at 11kV and domestic consumers are supplied at 415V. The 22kV distribution system is introduced from Phase XI to cater for special needs of New Port Project.

A three phase, 50Hz system with effectively earthed neutrals at transmission voltage levels is applied.

There are currently Eight major power station sites. These are:

- Ras Abu Fontas (B) [609MW]
- Ras Abu Fontas (B1) [376MW]
- Ras Abu Fontas (B2) [567MW]
- Ras Laffan A [756MW]
- Ras Laffan B [1025MW]
- Ras Girtas [2730MW]
- Mesaieed Power Company Ltd. (MPCL) [2007MW]
- Umm Al Houl [2520MW]

400kV network is connected with MPCL, Ras Girtas and Umm Al Houl Power plants. 400kV network links QTS network with transmission networks of Saudi Arabia and Kuwait as part of GCC regional grid.

The 220kV network is connected to Ras Abu Fontas (B, B1, B2), Ras Laffan (A, B) Power Stations.

The 132kV and 66kV substations constructed prior to QTS Phase 4 are mainly outdoor type, but all the recently built substations are equipped with indoor SF6 gas insulated metal-clad switchgear with power transformers located in an open area.

The 220kV substations are equipped with indoor metal-clad SF6 gas insulated switchgear. Three phase shunt reactors, installed to compensate capacitive reactive loadings, are connected at different locations to the network. Overhead lines circuits are normally of double circuit configuration on single steel lattice self-supporting towers and HV power cables are either cross-linked polyethylene (XLPE) or low-pressure oil filled type. Pilot cable / FO cables, laid in the same trench, accompanies each power cable circuit.

The 11kV distribution network consists of a cable network with neutrals earthed either through earthing resistors or earthing transformers.

The modern National Control Centre (NCC) was established under Qatar Transmission System (QTS) Extension Phase 4. Under QTS extension Phase V New Distribution Control Center (DCC) was established with latest Distribution Management system supplied by AREVA. With QTS expansion Phase VII project NCC has been upgraded to the latest AREVA EMS system and also new Emergency Control Center (ENCC) is established. The NCC performs the control and supervision of the transmission system, as well as load shedding and restoration on the 11kV distribution system. The DCC performs the control and supervision of Distribution Network.

Substation Control System (SCS) Gateways or SCADA remote terminal unit (RTU) are presently installed at each transmission and primary distribution substation. Each Gateway/ RTU is connected via duplicate routes in the data communication networks to the corresponding control centre (NCC/ ENCC or DCC). Mainly optical fibre communication system is used for data transmission with few substations connected via PLC or pilot copper cable due to limitation of transmission medium.

2. SITE CONDITIONS

The State of Qatar is an independent Arab State situated on the western coast of the Arabian Gulf. It is a peninsula covering an area of 11,437 square kilometers that extends northwards into the Gulf for about 160km and has a maximum width of 88km. A few offshore islands also comprise the territory of Qatar. On the westward neck of the peninsula, Saudi Arabia and, on to its east, United Arab Emirates are situated. The landscape of the state is generally flat and low lying except for a slight rise in the Dukhan area in the west. Almost the whole area of the state is a desert, except for some vegetation at Al-Khor and Doha. The climate is arid and the atmosphere can be both salt and sand laden.

2.1 General

The general conditions for technical constructions and civil works are as follows:

Altitude	:	Less than 1000m a.s.l.
Ground Water level	:	2m - 70m
Pollution level (to IEC 60815, Table I)	:	Very heavy
Creepage distance (based on Um)	:	35mm / kV
Isokeraunic level	:	22 days / annum
Lightning current for protective earthing	:	60kA$_{peak}$
Seismic intensity (Modified Mercalli Scale):		Approx. VI
Max. ambient temperature (design)	:	50°C
Max. relative humidity (design)	:	100%

2.2 Meteorology

The following meteorological information is set out for general guidance:

- Monthly mean temperature (January / July)	17.2°C / 34.9°C
- Mean maximum temperature (January / July)	21.9°C / 41.6°C
- Mean minimum temperature (January / July)	13.1°C / 29.5°C
- Absolute maximum temperature	49.6°C
- Absolute minimum temperature	3.8°C
- Maximum sun radiation temperature (design)	84°C
The difference between the mean daily maximum and the mean daily minimum temperature varies from 8.8°C in the winter to 13.3°C in the summer	

Mean relative humidity	42% to 71%
Mean maximum relative humidity (January)	88%
Mean minimum relative humidity (June)	20%
Absolute maximum relative humidity	100%
Absolute minimum relative humidity	4%

Mean sea level pressure (January / July)	1019.1hPa / 997.6hPa

– Highest daily global radiation	802.7 Wh/m^2
Ultra Violet Radiation (U.V.) levels are high and all plastics, subject to direct sunlight, shall contain a U.V. barrier.	

– Atmosphere	Saliferous, humid, H_2S from refinery

– Mean monthly rainfall (March / July)	20.9mm / 0mm
– Mean annual rainfall	80.9mm
Mean number of days with rainfall (1mm or more)	9.2 days / annum
Absolute maximum monthly rainfall	155.4mm
Absolute maximum daily rainfall	80.1mm

– Mean daily wind speed	10 knots
– Maximum wind speed sustained for 10 minutes	40 knots
– Maximum wind speed sustained for 1 hour	36 knots
– Absolute maximum wind speed gust recorded	92 knots

A special weather phenomenon that affects Qatar is the prevailing NW/NNW wind. Occasionally very strong southeast winds are experienced. Strong winds occur accompanied by sand and dust storms

2.3 Geological, Hydrological and Geotechnical Conditions

Basic features relating to the above heading in the State of Qatar can be summarized as follows:

Geological formations belong to the Quaternary sediments and Tertiary formations.

Quaternary sediments range from beach deposits, over fine-grained and coarse-grained alluviums to Aeolian sands. These deposits are, in general, unconsolidated with a thickness not exceeding a few metres, typically 1 to 2 metres.

Tertiary formations include limestone, dolomite, chalk and shale with clay and gypsum interbeds. In some areas significant karstification process has taken place.

The ground water in the coastal belt (10-15 km) is under the influence of seawater, while in the inner part of the Peninsula fresh water takes over. The ground water table tends to be rather high (close to the ground surface) in the lower ground areas of Doha and in swamps in the western part of the Peninsula.

Part of Doha new development (north) is planned on the land reclaimed, by poorly compacted fill, probably of granular (self-draining material).

Geotechnical properties of the above formations are generally suitable for the type of structures proposed under the Project.

The geological and geotechnical site investigations should be directed towards identifying the following properties and problems that might occur.

Geological and geotechnical structures of formations using adequate sounding and/or drilling techniques.

"In Situ" Geotechnical properties using adequate tests.

Ground water table, including seasonal oscillation.

Chemical composition of soils and ground water, with the emphasis on soluble salts (Sulphate) content.

The Contractor shall be required to study excavation and foundation conditions to the extent of providing for adequate safety of the structures under consideration. Particular attention shall be paid to the following:

Bearing capacity of the footings shall be considered in relation to the settlements that can be absorbed by the structures without structural and/or functional damage.

Foundation level should be above the water table whenever feasible.

In the aggressive environment the foundation shall be made in dry conditions in order to provide for an adequate protection of foundation structures (footings, rafts) against corrosion of concrete.

If the foundation has to be excavated into the fine granular material below the water table, an adequate dewatering (a network of point-wells is recommended) must be provided.

Piled foundation should be provided with long-term protection against corrosion of concrete.
Adequate protection against foundation failure due to sinkhole formation in the karstified carbonate rocks (limestone, dolomite, etc.)

2.4 Water Analysis

The Contractor is advised to test the ground water upon award of the Contract at reasonable intervals and to base the final selection of the embedded materials and its corrosion protection on their own findings, all upon approval of KAHRAMAA.

2.5 Transport and Communication

Transport Conditions

The trans-shipment ports to be considered for all sea-borne deliveries from abroad are Doha or Umm Said, which are connected to the existing road network.

The destination for air-freight purposes is Doha Airport. The airport is directly connected to the existing road network.

In general the major roads are asphalt paved and in good condition. No regulations are enforced for limiting the axle load of road vehicles. However, it is the practice to design the roads for 13 tons single-axle loads. When low load trailers for transport of heavy goods are used on the older roads, the single-axle load should not exceed 10 tons. Bridges have, for about the past 25 years, usually been designed according to standard HS20-44 American Association of State Highway Officials (AASHO) for a wheel load of 12.5 tons.

Clearance of bridges is usually 5 m for older bridges and 5.5 m for newly constructed bridges.

There are no railway facilities existing in the region.

Transport Equipment

All transport equipment has to be provided by the Contractor.

Communication System

Existing substations are connected to the private telecommunication system based on PLC links, pilot and communication cable links, microwave and fibre optic links and radial radio links. However, these links are not available to the Contractors. Therefore, the Contractors should provide their own way of communication between the sites and/or their offices.

2.6 Environmental Aspects

Air Pollution

Air is heavily polluted with dust and a high percentage of salt.

Water Pollution by Oil

Transformer foundations prevent the risk of ground water contamination by oil. Placing these units on oil tight catchment foundations will prevent water pollution by leakage from transformers.

Sewerage

Where connection to the sewerage system is not possible, foul water from toilets will be discharged to septic tanks.

3. GENERAL TECHNICAL REQUIREMENTS

3.1 System of Units

Technical Data dimensions, quantities, etc. throughout this Contract shall be in the SI-system of units (International System of Units).

3.2 Standards

Except where otherwise specified or implied, the Contract Works shall comply with the latest applicable specifications of the International Electro technical Commission (IEC) or the British Standards Institution (BS).

All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of goods, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the Specifications, shall comply in every respect with the Gulf Cooperation Council Specifications and Standards endorsed by the Government of Qatar or applicable in Qatar.

In cases where the above specifications are not applicable the technical codes of the International Organization of Standardization (ISO), International Telephone and Telegraph Consultative Committee (CCITT), ITU-T4 International Radio Consultative Committee (CCIR-Recommendations) for telecommunication equipment shall be applied.

Goods and special guarantees beyond the scope of IEC, BS and ISO shall conform at least to one of the following National standards and codes:

American: ANSI, ASME, ASTM, IEEE, NEMA
German: VDE, VDI, DIN or equivalent

The Rules and Regulations of KAHRAMAA must be considered, e.g.:

- Safety Rules for the Control, Operation and Maintenance of the State Electricity Departments High Voltage System (First Edition 1978)
- External Circular No. (1) of year 1404 (Ministry of Municipal Affairs, Doha Municipality, dated 4 February 1984).
- Circular No.2 regarding Thermal Roof Insulation, Inspection Procedure (MEW, Electrical Department dated 8th October 1983).
- Circular No.6 regarding Conditions for Execution of Public Service Works in the Vicinity of EHV Electricity Installations (MEW, Electrical Department dated 12th May 1991).
- Codes of Practice and Specification for Trench Works in the highway (Ministry of Industry and Public Works, Engineering Services Department, Highway Maintenance Section, January 1992).
- Qatar Construction Specification - 2014.
- System Operation Memoranda and System Operation procedures of KAHRAMAA.
- KM interlocking document
- ET-P26G1 Guidelines for Protection Energy Meter Requirements for Power Supply to Bulk Customers
- ET-P26-G2 Guidelines for System Control Requirements for Power Supply to Bulk Customers
- ET-P20-S1 Transmission Protection Standards for TA and ET Projects
- Regulations for the Installation of Electrical Wiring, Electrical Equipment and Air-conditioning Equipment.
- Rules, Regulations and Code of Practice for Design & Installation of Air-conditioning, Heating, Ventilation and Refrigeration (AC HVR) Systems for Government Buildings.
- Memorandum regarding Clearance and Removal of Buildings (Council of Ministers General Secretariat: dated 6.3.1983).

The work must be performed in accordance with the latest revision of standards, accident prevention regulations and legal regulations.

National standards, other than those listed above shall not be accepted.

The Contractor must clearly state his proposal concerning the use of standards and codes.

All the recommendations contained in the relevant applicable standard shall be considered as mandatory requirements. Specific requirements and special design features detailed in this specification over and above those clarified in the applicable standards shall be complied with.

Immediately following the Award of the Contract, the Contractor shall supply an indexed list in the English language, of all standards, codes and their referred associated standards, to which the work is to be performed.

3.3 Design, Standardization and Interchangeability

The works shall be designed to facilitate inspection, cleaning, maintenance and repair. Continuity of supply is of prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the works. The equipment shall be designed to operate satisfactorily under all variations of load, pressure, and temperature that may be met in normal usage under the variation in climatic conditions given in the Specifications. All apparatus shall

also be designed to ensure satisfactory operation in all atmospheric conditions prevailing at the sites and during such sudden variation of load and voltage as may be met with under working conditions on the system, including those due to faulty synchronizing and short circuit.

The design shall include all necessary interlocks for the operation and maintenance of the equipment in accordance with KAHRAMAA safety rules, standard interlocking document and system operation/maintenance practices of the Contract Works and of associated works supplied under other contracts.

All outdoor apparatus and fittings shall be designed so that water cannot collect at any point.
Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment that is in tension or subject to impact stresses.

Kiosks, cubicles and similar enclosed compartments shall be equipped with anti-condensation heaters actuated by hygrostat and thermostat to restrict condensation. All contactors or relay coils and other parts shall be suitably protected against corrosion.

All apparatus shall be designed to obviate the risk of accidental short circuit due to animals, birds, insects, mites, rodents or micro-organisms.

Corresponding parts throughout shall be made to gauge and shall be interchangeable.

All equipment performing similar duties shall be of the same type and manufacture in order to limit the stock of spare parts required and maintain uniformity of plant and equipment to be installed.

3.4 Materials and Workmanship

Materials used in the manufacture of the specified equipment shall be of first class quality and of the kind, composition, and physical properties best adapted to their various purposes in accordance with the best engineering practice. All equipment shall conform to the applicable standards as to material, workmanship, design and tests.

Tolerances, fits, and finishes shall conform to the best modern shop practices in the manufacture of finished products of a nature similar to those covered by the Specification. All equipment shall be of rugged & durable construction, designed for frequent operation.

The materials used for the construction of the plant shall be selected carefully for the purpose intended and with due consideration of site conditions and tropical environment. Higher grade material shall be used in every case where ordinary material may be insufficient.

If the Contractor desires to use stock material or components not manufactured especially for works under this contract, he shall submit evidence by presentation of respective certificates, to the KAHRAMAA's satisfaction, that such material or components comply with the requirements stated in the Specifications and to an approved standard and that the quality of such material is adequate for the intended use.

The Contractor shall indicate in the respective Technical Schedules the proposed materials and their applicable standards for all major items of the supply. Material specifications, including grade of class, shall be shown on the appropriate detail drawings submitted to KAHRAMAA for approval.

All works shall be performed and completed in a thorough workmanlike manner and shall follow the best modern practice in the manufacture of high-grade equipment. All work shall be performed by workmen skilled in their respective trades.

The Contractor shall guarantee for the quality of all materials, paints, treatments, as well as for the efficiency, losses and technical performance of the equipment in strict compliance with the Contract Documents and particularly with the provisions of the Scope of Works and Specifications.

3.5 Tools

The following three kinds of tools can be distinguished:

- Standard tools
- Erection, installation and commissioning tools
- Special equipment and tools

Standard Tools

The Contractor shall provide a complete set of standard tools for each type of installation/plant to enable the adjustment and maintenance of the plant to be supplied under this Contract. These tools shall be mounted in mobile lockable cabinets and shall be delivered to the KAHRAMAA stores on completion of the commissioning period.

One set of tools necessary for the operation of the equipment shall be supplied along with the equipment and kept at site on wall-mounted cabinets adjacent to the equipment.

These standard tools shall be supplied direct to KAHRAMAA brand new, i.e. they shall not be used for erection and installation purposes during the construction of the plant.

3.5.1 Tools and Equipment for Erection, Installation and Commissioning

The Contractor shall provide all tools and special equipment required to erect, install and commission the plant to be supplied under this Contract.

These tools and equipment shall remain the property of the Contractor and will therefore, after commissioning, be exported from Qatar. Alternatively, ownership of all or part could be transferred to KAHRAMAA for a price to be mutually agreed upon at a later date between KAHRAMAA and the Contractor.

3.5.2 Special Equipment and Tools

Special equipment and tools shall be provided by the Contractor to enable the erection, installation, overhaul, maintenance and commissioning of each particular item of plant to be supplied under this Contract. The Contractor shall provide brand new special equipment and tools on completion of the Warranty Period.

The Tenderer shall indicate the recommended special equipment and tools that he deems necessary for the purposes mentioned above. All special equipment and tools so determined shall be listed in the Schedule of Prices, together with their individual prices.

The definite list of the recommended tools to be purchased, taking into consideration the Contractors list of recommended special equipment and tools, will be prepared in due time by KAHRAMAA, in cooperation with the Contractors, in order to avoid needless duplication of tools. The prices stated in the Schedules shall be kept firm up to the expiry of Warranty Period. KAHRAMAA reserves the right to alter the specified quantities or cancel any or all items, at its sole discretion.

All special tools and equipment shall be marked to enable identification of their use.

3.6 Spare Parts

3.6.1 General

The required categories and minimum quantity of spare parts are indicated in Appendix B, Schedule of Prices. KAHRAMAA shall be given the option to cancel any or all items from the list included in the Schedule of Prices. Hence, it is obligatory upon the Contractor to submit the list of spares for each equipment for approval before ordering/manufacturing.

Beside the specified spare parts, the Contractor shall list in detail the recommended spare parts he considers necessary for safe and reliable operation and maintenance, together with individual prices, in the respective Schedule of Prices. KAHRAMAA reserves the option to order all or part thereof or supplementary spare parts. These prices shall be kept firm up to the expiry of the Warranty Period.

The "Recommended Spare Parts" shall be completed on the assumption that the spare parts listed shall be sufficient for an operation period of five (5) years after commissioning, as well as essential replacement parts to cover the event of a breakdown which would affect the availability or safety of the plant. The "recommended spare parts" shall cover all items required for the first overhaul of the GIS.

The Contractor shall ensure that sufficient spare parts and consumable items are available for his own use during commissioning of plant. Spares ordered by KAHRAMAA shall not be used by the Contractor.

Any spare apparatus, parts and tools shall be subject to the same specification, tests and conditions as similar material supplied under the Work Section of the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the plant and must be suitably marked and numbered for identification and prepared for storage by greasing or painting to prevent deterioration. All spare apparatus or materials containing electrical insulation shall be properly packed and delivered in cases suitable for long-term storage. Such packing shall be subject to approval of KAHRAMAA.

All short shelf-life material shall be replaced at the end of the Warranty Period.

Four (4) copies of storage instructions in the English language shall accompany all spares. One copy of the instructions shall be available inside the package.

The spare parts are to be delivered to the storehouse of the Contractor with catalogues labels, brands and other signs for their identification, everything to the complete satisfaction of KAHRAMAA and these shall be delivered to KAHRAMAA's Stores prior to Taking Over. Spare parts shall be delivered to stores with necessary coding as per Kahramaa practice.

The Tenderer shall guarantee that spares suitable for the plant provided under the Contract, without any modification to the plant, will be available for a period of twenty (20) years regardless of obsolescence of the plant items themselves.

3.6.2 Spare Parts List and Interchange ability Record

The SPIR (Spare Parts List and Interchangeability Record) shall be part of the final dossier and shall be provided at the same time as the Operation and Maintenance Manuals for approval and final issue and with the same number of copies.

The SPIR form consists of a main sheet and a continuation sheet, both sized A3. Reduced specimens of both sheets are incorporated in this item.

The action required to complete the SPIR form and its continuation sheet, if necessary, is described in the following parts:

Part 1 covers columns 1 to 12 incl., 19 and 20. It describes information to be provided by the equipment manufacturer.

Part 2 covers columns 13, 14, 15, 18 and block 21. It describes the action to be taken either individually or jointly by:

- CONTRACTOR

- KAHRAMAA

The responsibilities of any of the parties cannot be specified here but are usually clearly defined in the relevant Project Specification.

Part 3 covers columns 16, 17 and Authority block 22. It describes the action to be taken by the party/parties usually nominated in the Project Specification.

1. DETAILED INSTRUCTIONS FOR COMPLETION OF PART 1

(Columns 1 to 12 incl., 19 and 20)

It is recommended that the columns be completed by the equipment manufacturer in the following sequence:

Column 1 Enter the same equipment registration number or tag number for each piece of equipment as stated in requisitions and / or purchase orders.

Column 2 Manufacturer's model, type or other positive identification reference of the equipment / instruments ordered.

Column 3 Manufacturer's serial number or other control reference of the equipment / instruments as supplied.

Column 4 Total number of pieces of identical equipment / instruments as quoted in columns 1 to 3 and 6.

Column 6 purchasing Company's order reference number

Column 8 Describe all parts in the English language.
List all parts which should be carried in stock for normal operation and also list slow wearing parts.
If an item is interchangeable between two or more units it should be listed once only.

Column 9 For each part entered in column 8 enter the drawing number or reference number

NOTE: These drawings should be attached to the SPIR by the manufacturer.

Column 10 Enter the reference numbers/letters or other formation which identifies each part. Interchangeability with identical parts within the manufacturer's range should be indicated.

Owing to the wide variety of systems in use for identification of parts, it is impossible to lay down firm rules for completing these columns. Manufacturers should give whatever identification system they use to positively identify parts and to show interchangeability with existing equipment.

Manufacturer's final cross-sectional drawings, workshop drawings and real part numbers may not always be available in the early stage of manufacture. This may cause delays in timely preparation of manufacturer's recommendation for initial spare parts* in column 12 and subsequent ordering of same.

If delays are unacceptable, it is recommended that reference is made to manufacturer's documentation which is readily available, such as pamphlets, brochures, exploded views, typical drawings of similar equipment

Manufacturers are advised that "initial spare parts" are defined as follows:

"Initial spare parts are to safeguard the operation of equipment during the running in and starting up period and the quantity should be adequate to cover the period until the arrival of spare parts for normal operation. Later period should be practical purposes be taken as approximately 1 year.

Initial spare parts must therefore be ordered at such an early date that ideally they will arrive at site at the same time as the parent equipment, but in any case prior to start-up".

Column 11 Enter material specifications in terms of full international standards and accepted conventions, not manufacturer's or sub-manufacturer's references.

Column 5 For each unit or group of identical units, enter in the appropriate space the number of parts fitted in each unit of equipment or instrumentation.

Column 7 Enter the total number of identical parts in all equipment specified. In the case of identical units multiply the quantity in column 5 by the number of units given in column 4.

Column 12 Enter manufacturer's recommended quantities of initial spare parts which are likely to be needed during start up and the first year of normal operation.

If necessary manufacturers should seek technical guidance from the party nominated and responsible for action, as detailed in Part 2.

Column 19 Enter the approximate ex-works price per piece of each part in the currency shown at the top of the column.

Column 20 Enter the original manufacturer's identification numbers of all items of third party manufacture "bought-out" items such as ball bearings, oil seals, mechanical seals, couplings.

NOTE: Manufacturers must not complete columns 13-18 inclusive nor blocks 21 and 22

2. DETAILED INSTRUCTIONS FOR COMPLETION OF PART 2

(Columns 13, 14, 15, 18 and block 21)

It is recommended that the columns are completed by the engineering contractor and / or the operating company Materials Spare Parts Advisor as the case may be in the following sequence:

Column 18 For instrumentation this column should be left blank. Other equipment and its spare parts should be classified in accordance with the guidance given in Section (5) of the manual.

Equipment Classification

Equipment meeting the "vital" definition should be coded V

Equipment meeting the "essential" definition should be coded E

Equipment meeting the "auxiliary" definition should be coded A

Spare Parts Classification

Parts identified as "consumable" should be coded C

Parts identified as "replacement" should be coded R

Parts identified as "insurance items" should be coded

Column 13* Having duly scrutinized the manufacturer's recommendation in column 12, calculate the quantities of initial spare parts recommended in accordance with Section (4) of the manual and enter the results in column 13.

- To avoid any misunderstanding by users of the completed SPIR forms, it is emphasized that the quantities calculated and entered in columns 13, 14 and 15 must not be ordered, since they represent only recommendations / technical approval.

3.7 Packing, Shipping, Transport and Lifting Devices

3.7.1 Packing

The Contractor shall prepare and pack all materials and equipment for shipment in such a manner that they are protected from damage during shipment, and shall be responsible for and make good any and all damage resulting from improper packing, whether this is done at his own works or those of any supplier.

All electrical parts and delicate mechanical parts subject to damage from moisture shall be packed in hermetically sealed metal containers, in plastic envelopes, or in other approved containers within their respective packing cases, containing silica-gel bags.

All apparatuses shall be carefully packed for transport by sea, rail and road as necessary and in such a manner that they are protected against climatic conditions including conditions of temporary storage on site.

Spare parts shall be packed separately for long-term storage and delivered to KAHRAMAA Stores.

All cases, packages, etc. shall have KAHRAMAA standard shipping marks and shall be clearly marked on the outside to indicate the net weight, gross weight and dimensions, the parts contained therein, contract number, port of destination, the position of the centre of gravity and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents. All these shall become the property of KAHRAMAA after delivery.

Containers and packings shall be non-returnable type.

All stencil marks on the outside of cases shall be either of a waterproof material or protected by shellac or varnish to prevent obliteration in transit.

Each crate or package shall contain a packing list in a waterproof envelope. All items of material shall be clearly marked for easy identification against the packing list.

2 copies of the complete bill of lading showing the number, size, marks, mass and contents of each package shall be mailed or faxed to KAHRAMAA immediately the material is dispatched.

3.7.2 Shipping and Transport

The Contractor shall be deemed responsible for the following:

- to load and transport the equipment and material from the place of manufacture whether, this is at his own works or this of any supplier, to Qatar ports;
- to off-load, clear and transport to site all plant, equipment, etc. including temporary storage;
- to obtain permission from relevant Qatar authorities to use docking, airport or Site unloading, highway and bridge facilities required for transport of his equipment;
- to insure to the full value of the equipment and material for freight, for securing and forwarding of all shipping documents and for the payment of all shipping and unloading documents and charges;
- to obtain and verify all information specified regarding transport limitations;

- to obtain and verify all information specified regarding adequate handling equipment for unloading the heaviest prices of equipment;

- to bear all costs of repair or replacement of the equipment arising from damage during transport and unloading (Repairs to the damaged primary insulation is not acceptable);

- to select proper routes to meet his needs and shall bear all extra costs resulting from the selection of such routes.

The costs, if any, for adjusting, modifying roads and bridges shall be borne by the Contractor. The Contractor shall submit to approval the method of transportation and routes he proposes to use.

The Contractor shall inform KAHRAMAA of the anticipated shipping date by a 30 days written notice containing identification, symbol, description, weight and sizes of material in the shipment. Advance notice and slipping documents shall be sent by fax before air-mailing.
KAHRAMAA shall be also notified of the actual date of shipment.

The Contractor shall immediately report to KAHRAMAA any claims made against him arising out of alleged damage to a highway or a bridge.

Reference shall also be made to Clause 2.5 of this Section.

3.7.3 Lifting Devices

The maximum lifting capacity at the Port of Doha is 2 jib cranes with a capacity of 50 tons at 6m radius, maximum hook height above mean high water level is 22 m.

The Contractor shall provide bolts with shackles at conveniently selected spots of equipment in order to facilitate the handling and lifting of supplied equipment.

Special lifting and handling equipment, to be supplied by the Contractor in accordance with the Technical Specifications, shall be shipped together with the component for which they are provided.

The Contractor shall make his own arrangements and enquiries with regard to the loading, unloading and transport of all Construction equipment and material required for the Works. He shall make all necessary investigations as to the heaviest loads that can be handled at ports or transported to the Site by road, in particular with regard to the weight-bearing capacity of all bridges and culverts, and he shall comply with all relevant regulations of the Government Department connected therewith.

3.8 Labels and Plates

All items of plant shall be provided with a label indicating the purpose and service positions. The labels shall have classification numbers identical to those that shall appear in all drawings, lists and documents to be prepared by the Contractor. KAHRAMAA standard numbering scheme shall be strictly adhered to.

All items of plant shall be provided with nameplates, indicating the name of manufacturer, type, serial number, year of manufacture, main characteristics, and all further information that may be necessary for a precise identification of the equipment.

In addition, the Contractor shall supply all instruction and warning plates necessary for safety of operation and personnel.

Labels and nameplates for plant and equipment identification and record purposes shall be made of stainless steel with a matt or satin finish to avoid dazzle from reflected light and engraved with black lettering of a size which is legible from the working level.

Warning plates shall be made of stainless steel with a matt or satin finish, engraved with red lettering and sited in a position that affords maximum personnel safety.

Colors shall be permanent and free from fading.

All equipment within panels and desks shall be individually identified by satin or matt finish steel labels or laminated plastic labels where approved.

All labels, nameplates, instruction and warning plates shall be securely fixed to items of plant and equipment with stainless steel rivets, stainless steel self-tapping screws or other approved means. The use of adhesives will not be permitted.

Each main and auxiliary item of plant shall have a rating plate of indelible material permanently attached to it in a conspicuous position. It shall be engraved with the information specified as a requirement in the appropriate IEC, such as: any identifying name, type or serial number; details of the loading conditions under which the item of plant has been designed to operate; and any diagram plates as may be required by KAHRAMAA.

Each phase of alternating current and each pole of direct current equipment and connections shall be colored in an approved manner to distinguish phase or polarity.

Phases of three phase alternating current systems shall be identified as follows: -

Phase	Colour
R	Red
Y	Yellow
B	Blue

Colored and lettered discs, attached at the following locations (where appropriate), shall identify the phases on plant: -

(a) Outdoor switchyard tubular busbar structures, midway between taps and at tapping points.
(b) Outdoor Switchyard On tensioned busbar structures, or other tensioned connection spans, next to the anchor points at one end of every span.
(c) On line gantries, transformer gantries, next to the anchor points.
(d) On each transformer, or reactor tank
(e) On GIS busbar chambers and circuit breakers.

Such nameplates or labels shall be of non-hygroscopic, non-transparent or translucent heat, resisting material with engraved lettering of a contrasting color. They shall withstand the effect of wind laden with sand and Sea salt.

The nameplates or labels for indoor switchgear and circuit breakers shall be of stainless steel material with black enamel engraving. Size, color and engravings shall be subject to acceptance by the KAHRAMAA.

Items of plant, such as valves, which are subject to handling, shall be provided with chromium plated brass not less than 3 mm thick with the engraving filled with enamel.

The interior of each piece of equipment shall be clearly marked to show the phases and for this purpose either colored plastic discs screwed to fixed components or identification by means of plastic sleeve or tape shall be used.

A label on top of each board, on the front and also on the rear, if accessible, shall denominate its function. Further, labels next to each device mounted on the board shall identify such devices by means of a code number, and, if necessary, a proper name.

Each single piece of equipment mounted inside the boards shall bear a clearly visible identifying tag with an item number. No loose tags are acceptable.

The cable terminals shall be labeled equally and bear item numbers as well as an abbreviation of their destination. Plastic strips shall not be used.

The terminal blocks as well as all wires shall also be labeled with a code number and color coded where applicable. IEC Standards shall be followed.

All inscriptions shall be generally in the English language, except in certain instances where labels should be provided in both English and Arabic inscriptions, as required by KAHRAMAA. Warning plates shall be in both English and Arabic.

Size, content and lettering of labels and plates shall be subject to approval of KAHRAMAA.

3.9 Training

3.9.1 Training at Contractor's Factory

If Kahramaa requires, the Contractor shall provide training for KAHRAMAA personnel (max. 4) at manufacturer’s factory, for a duration of approximately 3 months (max.), during the detailed design process. The costs related to travel, and accommodation of KAHRAMAA personnel during training shall be borne by KAHRAMAA.

3.9.2 Training at Site

From commencement of erection until the taking over of the Work, the Contractor shall instruct those employees designated by KAHRAMAA, who will subsequently be responsible for operation and maintenance of the equipment.

An effective training program including proper classroom training for each equipment to cover equipment introduction shall be presented to ensure that, by the time any section of works is taken over, KAHRAMAA's personnel have been trained to operate the equipment and carry out maintenance of the works efficiently and safely.

The training programme shall be carried out during erection, commissioning and warranty period, as follows:

1. During Erection

Training of KAHRAMAA's personnel for the erection, dismantling and adjustment of the equipment to be carried out during maintenance of the plant.

2. During Commissioning

Training of KAHRAMAA's personnel to operate the equipment.

3. Before Taking Over Certificate

Training of KAHRAMAA's personnel how to carry out maintenance of the plant with all necessary checking, adjustment and the use of testing results for the same.

Training and Instructions shall be given in English and/or Arabic and there shall be no constraints on the number of personnel taking part in on-site training program.

The cost of such instruction and training both on-site and overseas shall be deemed to have been included in the Contract Price.

3.10 Documentation

Required Documentation

3.10.1.1 General

The following clauses specify the information, documents required from the Contractor during the period of Contract.

Refer also to the relevant General Conditions of Contract.

The Contractor shall submit to KAHRAMAA the documentation as may be required herein and as requested in the Technical Schedules.

All information, documentation, calculations, drawings, schedules, etc. shall be submitted within such periods or at such dates which are required to guarantee a smooth handling of due project without any delays. The Contractor is responsible for submitting all documentation in accordance with a programme to be prepared by him allowing all participants sufficient time to check, comment and eventually approve the documents.

The quality of the submitted documents must be in accordance with acceptable international practice and allow a speedy checking procedure. Documents not fulfilling these requirements will be returned to the Contractor without comments for improvement and resubmission. It is solely at the discretion of KAHRAMAA to decide whether or not documents are acceptable.

All drawings shall be drawn to one of the preferred scales quoted in Table 7 of BS Publication PD 6031 and on paper of the appropriate sizes.

Graphical symbols shall be in accordance with IEC 60617 Parts 2 to 13.

All detail drawings submitted for approval shall be to the scale and not less than 1/25. All important dimensions, material shall be indicated in the drawing. Drawings shall not exceed A0 standard size.

PDF version of the documents shall be prepared directly from the original CAD version of the drawings/ schematics/ word documents/ excel worksheet/ MS Project files etc for clarity and better zoom in/ zoom out capability.

All dimensions marked in SI units on the drawings shall be considered correct although measurement by scale may differ there from. Detailed drawings shall be acted on where they differ from general arrangement drawings.

All drawings shall be black lines on a white background with all revisions clearly marked.
Title block to be used for all the drawings shall be subject to KAHRAMAA's approval.

Before the submittal of the first drawings or documents the Contractor is required to submit a complete Documentation Plan, i.e. a detailed list of all individual documentation submittals that are to be produced under the contract.

The minimum requirements as regards the various drawings to be submitted with the tender are specified in the Technical Schedules.

3.10.1.2 Mistakes in Drawings and Information

The Contractor shall be responsible for any discrepancies errors, or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by KAHRAMAA or not. The Contractor shall be responsible for checking and verifying all drawings and information supplied in writing by KAHRAMAA and for assessing details of special work specified by either of them.

3.10.1.3 Specification Drawings and the Tenderers Response

1) Specification Drawings

The drawings issued by KAHRAMAA with the Specification and forming part of the documents for tendering purposes are intended to be descriptive of the character of the works and used in conjunction with the requirements of the specification and shall in no way limit the responsibility of the Contractor to supply all plant equipment, materials and services necessary to provide for a complete and functional complex. Any omission from both drawings and the specification or express reference to any detail or work necessary and obviously intended shall not relieve the Contractor of his responsibility to include such detail or work in his supply.

The sizes of the building shown on the specification drawings are not final, since these are dependent on the size and shape of the Tenderer's plant, equipment and materials forming the works and the space required for installation, maintenance, laydown, storage, access, etc.

They are however to be considered as minimum requirements. Any deviation has to be stated in Departures from the Specified Requirements in the Technical Schedules.

When measurements are affected by conditions already established, the Contractor shall take and be responsible for field measurements notwithstanding any information set forth in the specification drawings.

The specification drawings portray the basic layout of the scope of works and the Tenderer shall incorporate these requirements in his tender drawings.

With regard to the interconnections to and the extensions of existing installations, the drawings and descriptions included in this specification shall be assumed to be descriptive to the extent necessary for tendering purposes.

After award of Contract, any available drawings of the existing installations will be made available by KAHRAMAA.

In this respect, the Contractor has to request the information in due time before starting with his detailed engineering works referring to the equipment and the corresponding section and clause of the specification.

The Tenderer has to ensure that the information provided within the specification is sufficient to state his final contract price.

The detailed list of drawings issued by KAHRAMAA for tendering purposes is included in the Scope of Works.

The Tenderer is at liberty to comment on any documents and drawing issued with the specification within the time specified in the Instructions to Tenderers. After the tender has been submitted the Tenderer is deemed to have checked all these documents and drawings and they are without any restriction accepted by him. No claim resulting out of omissions or discrepancies in this respect will be accepted.

2) Tenderer Response

The Tenderer shall submit together with his tender, drawings, diagrams, graphs, curves and all such information which is necessary to fully understand the tender from technical, financial and administrative point of view.

As a minimum requirement, the drawings, documents and information, etc. according to the specification and Instruction to Tenderers shall be supplied with each copy of the tender in sufficient detail to fully describe the scope of work and the services offered. The drawings shall be prepared on standard sized drawing sheets not larger than size A0 (840 mm x 1190 mm).

3.10.1.4 Outline Drawings

The Contractor shall submit to KAHRAMAA for review and approval:

- outline drawings of the equipment to be furnished under this Contract together with estimated weights, anchoring details, and sufficient overall dimensions.

3.10.1.5 Schematic and Connection Diagrams

The Contractor shall prepare and submit to KAHRAMAA:

- Schematic Diagrams - The content of these drawings shall show, in detail, all components of the circuit and the purpose and operation of the component within the circuit, including all external remote located components, in a consolidated form according to KAHRAMAA's practice. The diagrams shall show all device identifications, terminal numbers, wire numbers, and colour-coding. The schematic diagram pertaining to each circuit bay shall be fully self-contained and comprehensive, inclusive of all aspects of bay operation (such as switchgear, transformer, LCC, control, protection synchronising, voltage selection, indication, metering, etc.) as well as devices details, cross-references, etc.

- Connection Diagrams - These shall be produced for all devices, components and systems that require to be interconnected and shall show in detail how the various devices, components and systems are connected together. All cable, core and terminal identification numbers shall be included.

- Logic & Schematic diagrams for interlocking.

3.10.1.6 Detail Drawings

Before proceeding with manufacture of the equipment, the contractor shall submit to KAHRAMAA for approval:

- General assembly drawings, sufficient sub-assembly drawings, and details to demonstrate fully that all parts will conform to the provision and intent of the Contract Documents and the requirements of their installation, operation and maintenance. These drawings shall show all necessary dimensions and subassemblies in which the Contractor proposes to ship the equipment, schematic and connection wiring diagrams, and the terminal boxes and wire sizes for electrical circuits.

3.10.1.7 Calculations/Design Criteria

Likewise in addition to the drawings or whenever the contractual documents may so require, the Contractor shall submit to KAHRAMAA for checking and approval the design basis report for equipment and system:

- the appropriate calculations for determining the main sizes, dimensions and operational characteristics, clearly indicating the principles on which calculations were based.

3.10.1.8 Erection and Commissioning Instructions

The Contractor shall submit to KAHRAMAA for approval:

- all information necessary to permit a satisfactory erection, assembly and commissioning of the equipment. Detailed instructions for the erection of the equipment shall be submitted together with copies of applicable drawings showing the erection sequence.
  The instructions and drawings shall include information on handling and slinging the major pieces of equipment, erection, tolerances, and special precautions to be taken in installation.

3.10.1.9 Operation and Maintenance Instruction Manuals

Three (3) months prior to the issue of the Certificate of Operational Responsibility of each section, the Contractor shall forward to KAHRAMAA for its approval two (2) copies of Operation and Maintenance Instruction Manuals.
After checking and approval by KAHRAMAA, the Contractor has to provide:

- 3 sets hard copies
- 8 sets in CD ROMs

The Taking Over Certificate will not be issued until the required number of approved copies of the manuals has been provided by the Contractor.

The Instruction manual's contents shall conform to the table of contents and be as complete and specific as possible. Documentation shall be specific to the materials and equipment supplied under the Contract. Nomenclature or reference to any one item shall be consistent throughout the manual.

Use shall be made of drawings, diagrams, pictures or actual photographs when they add to the understanding and clarify the text.

All materials shall be free from stamps commonly used for identification of customer, order number, etc.

Precautions and warning relative to the safety of life and equipment shall be included.
The operation and maintenance manuals and instructions shall be provided in plastic folders for each page/leaf.

The instructions for operation shall be accurate and easy to understand and shall contain the sequence of individual manipulations required for operation. The information shall be prepared in such a manner that the contents can be also used for instructing untrained personnel in the operation of the control system and its components.

Tables, lists and graphic representations should be used as far as possible to make the description more readily understandable.

The maintenance manuals shall contain a complete and accurate description of the equipment, its assembly and dismantling as well as of all components and a copy of the relevant test reports. An accurate list stating clearances, tolerances, temperatures, fits, etc. is required.

The first page of each instruction manual section shall be a title page.

One section shall be concerned with regular and preventive maintenance and shall indicate the inspections required at regular intervals, the inspection procedure, the routine for equipment calibration and adjustment, the regular safety checks and similar types.

For the materials supplied by KAHRAMAA, if any, the relevant data shall be extracted from existing O&M Manuals and included in the manuals to be prepared by the Contractor. If pertinent information is not available with KAHRAMAA, the Contractor shall obtain the same from the original equipment supplier(s).

If it shall emerge during the erection, commissioning or warranty period of the equipment that the operating and maintenance instructions are inadequate or faulty the Contractor shall carry out and supply the necessary corrections and supplements.

The method of binding, segregation of contents and number of volumes for each section of works shall be to the approval of KAHRAMAA.

KAHRAMAA reserves the right to specify a uniform cover (loose-leaf folder) for all operating and maintenance instruction produced by the Contractor for individual equipment.

3.10.1.10 As-Built Documentation

After the completion of work on Site all installation documentation shall be revised where necessary to show the equipment as installed and two (2) copies of revised drawings shall be submitted to approval. These shall be endorsed "As-Built" and shall be correctly titled and carry KAHRAMAA's approval number, Contractor's drawing number and where appropriate KAHRAMAA's number allocated to the item.

The Contractor shall use a commercially available PC compatible word processing and adequate graphic software to produce its as-built deliverable documentation. The Contractor shall also provide 8 (eight) sets magnetic media copy of documentation, e.g., CD-ROMs, including O&M manuals. The media copy shall be a clean copy containing only the final version of each document.

All layout drawings connected to the equipment location, buildings, fences, etc. are to be attributed with absolute grid coordinates, and produced by CAD technology which is to be approved by KAHRAMAA. All geo-reference drawings (routes, locations, site plan, etc.) shall be produced in a format compatible with KAHRAMAA's Geographic Information System requirements of updated AutoCAD specification.

As-built drawings, layouts, etc. for the existing installations which are to be modified under this Contract shall be revised by the Contractor to show correctly the existing and modified work to give a correct record of the complete as-built works. This may require the Contractor to produce a new base negative from which good quality copies can be taken (in accordance with the above requirements) if the original negative is not available or the original negative made available is of poor quality.

These documents shall be deemed to form part of the works for the purpose of Taking Over of the works.

All drawings, samples and models shall be submitted in accordance with the provisions in the Schedules and shall become the property of KAHRAMAA.

3.10.1.11 Contract Documents

The successful Tenderer shall provide KAHRAMAA with:

- four (4) sets of original Contract Documents for signature based on the draft Contract Documents prepared by KAHRAMAA and approved by KAHRAMAA including Work Statement mutually agreed during Contract Negotiations, within four (4) weeks from the date of reception of the Letter of Award.

- twelve (12) working copies of the Contract Documents for KAHRAMAA's use, within 2 (two) weeks after signing the Contract.

The cost of printing of above mentioned documents shall be deemed to be included in the Contract Price.

3.10.1.12 Photographs

From the beginning of site works on Site the Contractor shall keep on providing photographs of the works, from positions to be selected by KAHRAMAA, at monthly intervals. Up to ten (10) photographs per month shall be provided in bound photographic albums, two copies of which shall be submitted to KAHRAMAA.

Each photographic print shall not be less than 297 mm x 210 mm and shall bear a printed inscription, a serial number and the date when taken.

The negatives of all photographs shall be held at the Contractor's site office, numbered and handed over to KAHRAMAA on completion of the Contract.

The Contractor shall provide a number of selected photographs for submission with the Monthly Progress Report as required by KAHRAMAA and also shall provide loose sets of photographs and copy negatives which may be requested from time to time by KAHRAMAA.
The Contractor shall provide additional photographs of the Contract Works to record or illustrate specific events at the request of KAHRAMAA.

3.10.2 Approval Procedure

3.10.2.1 Number of Copies Required

Two (2) copies of each drawing/documentation shall be submitted by the Contractor to KAHRAMAA for the approval/re-approval and construction purposes.

One (1) copy will be returned to the Contractor marked "Approved", "Approved with Corrections", or "Not Approved" with comments made either on the drawing itself or in the accompanying letter, and the drawing/documentation shall be amended and resubmitted for approval, clearly identifying the amendments.

The Contractor shall furnish two (2) copies to KAHRAMAA without delay if minor revisions are made after a drawing has been returned to the Contractor marked "Approved". No revision affecting the design shall be made after a drawing has been "Approved" without resubmitting the drawing.

The Contractor shall submit two (2) copies of each drawing/documentation marked "Approved with Corrections" or "Not Approved" for re-approval after making necessary corrections. At least two (2) copies shall have clearly marked amendments to the drawing. Revision column must be provided giving the date of revision letter and brief description of each revision. Any modified drawing shall have a new revision number.

Three (3) copies of all finally approved drawings/documentation shall be supplied by the Contractor as paper prints. These drawings shall have the revision column marked "Approved by KAHRAMAA" by the letter No…….. dated…….., with the drawing revision number, correctly modified.

3.10.2.2 Review and Approval of Documents

The Contractor shall ensure that all documentation for approval are forwarded to KAHRAMAA in sufficient time. The Contractor shall also ensure that documentation are submitted six weeks prior to the

date required for approval to permit amendments to be made and the drawings re-submitted for approval without delaying the programme deliveries or the guaranteed completion dates of the works.

Drawings marked "Approved" and "Approved with Corrections Indicated" authorize the Contractor to proceed with construction or fabrication of equipment covered by such drawings with corrections, if any, indicated thereon. Approved drawings must be available before any equipment is workshop tested or before any erection/construction work has started at Site.

The Contractor shall be responsible for any discrepancies or errors or any omissions from the drawings, except as provided for in the Conditions of Contract whether such drawings have been approved or not, and any approval given by KAHRAMAA to any drawing or sample shall not relieve the Contractor from his liability to complete the Contract Works in accordance with this Specification and Conditions of Contract or exonerate him from any of his guarantees.

Any drawing or document serving the purpose of information will not be stamped "Approved" but "seen by KAHRAMAA" only.

If the Contractor shall require approval of any drawing within fourteen days of its submission in order to avoid delay in the completion of the Contract Works he shall advise KAHRAMAA to such effect when submitting the drawing. However, such requests shall be kept to a minimum and KAHRAMAA reserves for itself the right to accept or reject such requests.

Drawings, samples and models already submitted by the Contractor and approved by KAHRAMAA (and such drawings, samples and models as shall be thereafter submitted by the Contractor and approved by KAHRAMAA) shall not be departed from.

Any drawing or document serving the purpose of information will not be stamped "Approved" but "seen by KAHRAMAA" only.

The Contractor shall also provide free-of-charge any additional drawings and/or copies of any drawing required by KAHRAMAA.

KAHRAMAA will not normally require to receive copies of detailed manufacturing drawings but the Contractor shall make these available, if so requested.

When submitting drawings for approval, including any prepared by a Subcontractor, the Contractor shall certify in each case that he has fully examined such drawings and that they fully comply with the requirements of the Contract. All documents submitted for approval shall bear the following remark (stamped and signed):

"This submission is declared to be strictly in accordance with the requirements of the Contract".

Signature

For the purpose of this Clause the term "drawing" shall include diagrams, schedules, performance curves, calculations, test reports, etc.

The Contractor shall make any changes in the designs which are necessary to make the equipment conform to the provisions and intent of these Contract Documents, without additional cost to KAHRAMAA.

The Contractor shall leave a blank area 100 mm x 70 mm on all drawings adjacent to the drawing title block for KAHRAMAA's approval stamp.
Should an error be found in a Contractor's drawing during the erection of structures or installation of equipment, the correction, including any design changes found necessary, shall be noted on the drawing and it shall be submitted for approval and recorded in the form of "Project Change Procedure" as outlined in Clause 3.12.5 of this Section, without additional cost.

3.10.2.3 Documentation Review Period

Drawings and calculation notes submitted by the Contractor for review shall be returned to the Contractor with comments or approval, as noted in previous clauses, within thirty (30) days of them being received. Should KAHRAMAA deem a longer period necessary for checking certain drawings, the Contractor shall be informed to that effect in writing, and within ten (10) days of receiving them.

3.10.3 Programme, Progress of Work and Reporting

3.10.3.1 Planning of Work

Due to the computerized cost and schedule control activity network diagrams and charts, the Contractor shall use Primavera project management software.

The Contractor shall produce three types of planning programme:

- A "Start Up" programme as an interim plan covering those activities due to take place in the first three months of the Contract.
- A contract programme which shall cover the whole of the Contract period in summary form and include all major activities.
- A project control programme which embodies all the major activities in the contract programme with the addition of all other activities in a computer based Critical Path Network.

1) Project "Start Up" Programme

Within 10 working days of Contract Award, the Contractor shall provide a project Start Up programme. The Start Up programme shall be of bar chart format, covering all activities scheduled for the first 13 weeks (3 months) from Contract Award.

The Start Up programme shall be used for progress reporting during the interim period whilst the contract programme is being produced and shall be updated regularly to indicate progress achieved. The Start Up programme shall be submitted as part of the Contractor's monthly progress report until replaced by the Contract Programme.

2) Contract Programme

Within 30 working days of the Effective Date of the Contract, the Contractor shall revise and re-issue to KAHRAMAA for review, the Tender Submission overall summary programme. After approval, this programme shall be Contract Programme.

All subsequent networks and programmes produced by the Contractor shall directly relate to the timescales of the Contract Programme.

The Contract Programme shall be presented in bar chart format with interdependencies clearly shown and all milestones and contract interfaces identified. It shall show only major activities as required by KAHRAMAA to provide a level 2 programme.

The Contract Programme shall be marked up by the Contractor monthly to indicate the progress achieved against each activity and submitted as part of the Contractor's monthly progress report. All reports on the Contract Programme shall show the original planned activities, duration and dates without change as well as any agreed modifications.

3) Project Control Programme

Within 40 working days of Contract Award, the Contractor shall produce and issue for review a Project Control Programme using the Critical Path Network (CPN) method.

The Contractor shall produce monthly reports from the programme which shall give:

Simple bar chart(s) of the activities contained in the network with the following identified:

- critical activities
- percentage completion (shown as bar shading)
- anticipated completion of all critical activities
- milestones
- interface points
- report date as vertical line

A full activity listing containing as a minimum the following fields:

- description
- duration
- percentage completion
- remaining duration
- early start
- early finish
- late start
- late finish
- total float
- constraints (precedence)
- modes (arrow)

The Contractor shall update the Project Control Programme to reflect the current state of contract progress.

The Contractor shall inform himself and make due allowance in his programme for the situation in the plant area and in the countries major centres during the periods of special public holidays, including religious periods and holidays.

3.10.3.2 Monthly Progress Report

At monthly intervals, latest on the 5th day of the following month during the contract, the Contractor shall submit Three (3) copies of the detailed progress reports.

The reports show clearly and accurately the position of all activities associated with design, material procurement, manufacture, shop tests, shipping, site erection, testing and commissioning with regard to the agreed contract programme.

The design aspect of the progress report shall include a comprehensive statement on drawings, calculations, proposals and schemes submitted for approval updated in the above mentioned intervals. The updated drawing list will be included to show the latest situation with submitted drawings and approvals.

The position on material procurement shall give me the date and details of orders placed and indicate the delivery quoted by the manufacturer. If any delivery date has an adverse effect on the Contract Programme the Contractor shall state the remedial action taken to ensure that delays do not occur.

The position on manufacture shall indicate the arrival of material, the progress of manufacture and date at which the equipment will be ready for transport. The information recorded shall also indicate all special occurrences (such as accidents, defects, etc.) which will affect the date of completion in the manufacturer's works.

The commencement of testing and commissioning, its duration details of any matters occurring during that period and the remedial action taken, the completion dates, etc. shall be noted and segregated for each group of the works.

All works tests executed shall be listed as well as the remarks on the test-results. Special indication shall be given to equipment not having fulfilled the test-requirements. The workshop tests intended for the following month shall be remarked.

The shipping of each order to part order shall be monitored on the progress report giving the date by which the equipment will be available for shipping, the estimated time of arrival on Site and the actual arrival dates.

The site erection portion of the progress report shall be segregated into the main and ancillary items of civil, mechanical and electrical work and each item of work shall be monitored giving the percentage completion and the projected completion date of the work in accordance with the agreed contract programme.

Any delay which will affect the completion, testing and commissioning dates of any item of plant shall be detailed by the Contractor who shall state the action he is taking to effect completion to the contract programme.
The Contractor shall report on various items of the groups of the works the erection equipment in use or held in readiness, a return of labor and supervisory staff, and details of any matters arising which may generally affect the progress of site work.

The Contractor shall give a summary of the detailed progress report giving the position with regard to the agreed contract programme.

The Monthly Progress Report shall be set out in a format to be agreed with KAHRAMAA within six (6) weeks after signing the Contract.

The progress report shall be forwarded promptly so that on receipt the information contained therein is not more than fourteen (14) days out of date. Each copy of the progress report shall include a summary written in the English and Arabic language.

If during execution of the contract KAHRAMAA considers the progress position of any section of the Work to be unsatisfactory, or for any other reason relating to the Contract, he will be at liberty to convene a meeting and the Contractor's Representatives are to attend such meetings.

3.10.3.3 Weekly Programme

In order to allow KAHRAMAA to provide necessary access/outages, etc. for work related to existing installations the Contractor shall attend a weekly meeting in this regard and a programme shall be tabled by the Contractor during this meeting.

The weekly programme shall contain a list of key events of the current week and programme for the following week.

3.10.3.4 Project Meeting and Minutes

Project meetings shall be held to review project status, to ensure fulfilment and correct implementation of the Specification, to review design and to maintain general coordination between KAHRAMAA's and the Contractor's project personnel.

There shall be two types of meetings: Project Progress Review meetings and Technical Discussion meetings. Project Progress Review meetings shall be held at regular monthly basis. In addition to the Project Progress Review meetings, Technical Discussion meeting shall be held on an as-needed basis. These meetings may be called by either party. A proposed agenda, mutually agreeable, shall be prepared and exchanged in advance. The agenda shall serve to suggest which project members should be present at each meeting.

The meetings will be held at either KAHRAMAA's office or the Contractor's premises or at Site. The Contractor shall prepare an agenda prior to each meeting for review and approval.

KAHRAMAA shall keep minutes of each meeting and shall submit copies of these minutes within five working days after the meeting. Any disagreements about the minutes of a meeting shall be resolved prior to or at the subsequent meeting. Resolutions of the previous meeting shall be written in the subsequent meeting minutes and shall become the official minutes for the given meeting.

In addition, during the course of the Contract periodical meetings to discuss project management and the progress of works will be held. The frequency must be considered as being once in three months during the course of the Contract. Location of each meeting shall be decided by KAHRAMAA. The Contractor shall be responsible for the complete costs of his own attendance at those meetings.

3.10.4 Procedure for Delivery of Documentation

Unless otherwise specified in the Technical specifications, the Contractor shall submit the following documentation/information to KAHRAMAA for review and approval.

Within 14 Days after Effective Date of the Contract

- Detailed project specific Quality Plans and associated procedures.

Within 30 Days after Effective Date of the Contract

- Detailed Contract Programme containing design, approval of design, ordering of materials, manufacture, shop testing, delivery, civil construction, erection, site testing and commissioning.
- Detailed list of documentation submittals with documentation classification plan.
- Detailed breakdown of the Contract Price into Cost Items as per Clause 11, Part I, General Conditions of Contract.
- Detailed proposal of the Monthly Progress Report format.
- Contractor's safety and security programme.

Within 60 Days after Effective Date of the Contract

- A programme of performance, material and workshop test to be carried out.
- Particulars about presentation and form to be used for the test programme shall be agreed and approved by KAHRAMAA.

Within 90 Days after Effective Date of the Contract

- Copies of all orders placed with Subcontractors.
- Safety programme.
- Fire prevention and protection programme.
- Outline drawings of the equipment.
- Loading of foundations for all items of equipment to be supplied, and details of anchoring and supporting.
- Delivery of all drawings related to civil works.
- Preliminary drawings and schemes of connections to the part supplied under other contracts.
- Preliminary assembly drawings of the equipment with details of material intended to be used (if applicable).
- Principal electrical diagrams (if applicable).
- Detailed information (type, make, formula) of products employed to carry out the factory paints.
- RAL colour code for finish paint of all equipment.

- Detailed training programme.

Before Beginning of Manufacture

- Detailed manufacture drawings/documentation and software designs with all important technical data, final assembly drawings, control schemes, block and circuit diagrams and giving full information about principle of operation, cabling and wiring diagrams.

During Manufacture

- Monthly progress reports,
- Notice of material tests and shop inspections,
- Certificate of inspections,
- Certificate of tests,
- Information concerning delays, claims, etc.

At least 30 Days Before Shipment

- Notice to KAHRAMAA giving identification, symbol, description, weight and dimensions of material in shipment.
- Bill of lading for each consignment just prior shipment.
- Instructions for loading, unloading, handling and special precautions to be observed for storage at Site.

At least 30 Days Before Commencement of Erection

- Three (3) copies of Certificates of Policy of Insurance related to the Site works.

At least 90 Days Before Commencement of Erection

- Erection instructions for approval.
- Approved erection instructions.
- Complete sets of approved drawings.
- Detailed erection programme for each component for approval.
- Site testing and inspection programme during and at the end of erection for approval.

During Erection

- Monthly Progress Report
- Weekly Programme

90 Days Prior to Certificate of Operational Responsibility

- Operating and Maintenance Instructions for approval.

90 Days Before Commencement of Commissioning

- Detailed programme and site test proposal (commissioning tests) for each section.

Before Taking Over

- Spare parts storage instructions
- Final commissioning report
- Final operating and maintenance instructions
- "As-built" drawings, magnetic media copy of as-built documentation (CD-ROM).

Within 15 Days after KAHRAMAA's Notice

- Revised Contract drawings.
- Any revised information which has not been approved earlier.

Within 15 Days after any Occurrence

- Report on any damage/accident (the first brief report on the occurrence on any damage/ accident shall be submitted not later than within 24 hours).
- Any error discovered by the Contractor in his own design.
- Test certificates or test reports unless otherwise agreed upon.
- Any failure of material and equipment.
- Any delays against schedules.

3.10.5 Project Design Change Procedures

Generally, there shall not be any changes in the design after award of the Contract.
However, if it will become necessary a Project Design Change Procedure for controlling project design changes shall be established. The purpose of the Procedure shall be to control any Project design changes after the design has been defined. The Procedure shall cover any proposed departure from the technical requirements contained in the Specification. The Project Design Change Procedure shall be subject to KAHRAMAA's review and approval.

The Procedure shall describe the proposed methods to be used by the Contractor in requesting and seeking authorization for any project design changes. As a minimum, the following information shall be included in any Design Change Request:

- A description of the proposed change,
- A definition of the magnitude of the proposed change,
- A definition of the base from which the proposed change has been evaluated,
- A discussion of the advantages and disadvantages of the proposed change including alternatives considered,
- Supporting technical documentation suitable for KAHRAMAA's evaluation,
- Price increase or decrease resulting from the change and
- Impact on schedule

It is KAHRAMAA's intention to process Design Change Requests within six weeks after presentation by the Contractor. Any change request is considered unacceptable until being approved in writing by KAHRAMAA. The acceptance or rejection of the Design Change Request is KAHRAMAA's prerogative to be exercised at its sole discretion. Acceptance of any Design Change Request does not relieve the Contractor from his responsibility for the accuracy, adequacy, or suitability of the installed plant.

3.11 Inspection and Tests

3.11.1 General

All materials and equipment used in the Contract Works are subject to inspection by KAHRAMAA. Two representatives from KAHRAMAA will also witness the first inspection as well as the type tests for all the major equipment. The Contractor shall assist KAHRAMAA in making hotel reservations for KAHRAMAA inspectors and also bear all costs of local transport for KAHRAMAA inspectors during inspection visits.

The Contractor shall at his own cost and expense execute shop and field tests of all materials and equipment supplied by him or his Subcontractor required in the Technical Specifications, in accordance with the provisions thereof and that of the applicable standards. This shall not preclude KAHRAMAA's right to call for further tests, if considered to be necessary.

Where the methods of tests are not specified in the standards or if there are options in the relevant standards, the Contractor shall submit to KAHRAMAA for approval the methods by which he proposes to conduct the tests. The Contractor is responsible for advising when equipment and materials are available for inspection and tests.

All equipment and materials necessary for execution of the tests shall be furnished by the Contractor. Measuring apparatus and their calibration certificates (validity period 12 months) shall be approved by KAHRAMAA.
The Contractor shall submit to KAHRAMAA for approval Two (2) copies of the test results showing conditions of tests performed, the test circuits and oscillograms, etc.

In the event of test results not satisfying the requirements of the Technical Specifications or guaranteed performance, the Contractor shall improve the equipment until satisfactory results are obtained and shall conduct retests at his own expense.

Any delay in delivery due to the retest shall not constitute a release of the Contractor from his responsibilities for delay. All expenses incurred by KAHRAMAA in attending the retest shall be borne by the Contractor.

No inspection or lack of inspection by KAHRAMAA of work, plant or materials, whether carried out or supplied by the Contractor or Subcontractor, shall relieve the Contractor from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

Procedures for those tests which are beyond the service conditions specified in the relevant standard(s), shall be submitted to KAHRAMAA for consideration and approval.

3.11.2 Shop Tests

The shop test shall be divided into type tests, sample tests, routine tests and special tests.
The tests generally described in the Technical Specifications as type tests, shall be carried out on one item of apparatus, etc., of each type and rating. If evidence is available of successfully carried out type tests on identical apparatus or apparatus which is for practical test purposes similar, in a recognized independent testing laboratory or independently witnessed, this may be accepted in lieu of these tests, if not otherwise specified in the Technical Specifications. The decision of KAHRAMAA shall be final in that respect. The type test documents must be submitted and evaluated before Award of the Contract.

Type test certificate for the electronic equipment shall not be older than five (5) years if no changes of hardware or software happened in the meantime and seven (7) years for the other equipment.

The tests generally described in the Specifications as routine tests, shall be made on each piece of equipment to be supplied.

The tests generally described in the Specifications as special tests, shall be made as required by the Specifications.

The shop assembled units shall be completed assembled, adjusted and tested at the shop. After assembly the complete units shall, as far as possible, be tested for operation under design conditions to assure the proper functioning of the equipment.

3.11.3 Site Tests

On arrival at site and during erection, all items of equipment shall be inspected and tested to avoid late commissioning caused by the supply of faulty or damaged equipment.

After the plant and ancillary equipment have been erected and connected up on site, the Contractor shall carry out to the satisfaction of KAHRAMAA such tests as may be required to prove compliance with the Specifications, independently of any tests carried out at the manufacturer's works.

Not less than 90 days before the commencement of commissioning, the Contractor shall submit for approval of KAHRAMAA his detailed site test proposals for that section of plant, together with details of the test equipment and methods that he proposes to use. Subject to approval of the tests, these will be written by the Contractor into an overall programme of tests, which will be issued to all directly concerned prior to the starting date for the tests.

KAHRAMAA shall have the right to witness all tests, and the results must be made available as the tests proceed. KAHRAMAA may recommend waiving of some tests, or may add further tests if considered necessary to prove compliance with the Specification.

The Contractor shall conduct the tests under KAHRAMAA's inspection at the Site during installation. Before proceeding with the installation works, the Contractor shall also request KAHRAMAA to inspect the necessary works which cannot be inspected if the installation works are advanced.

3.11.4 Test Reports and Programmes

a) Test Reports

The results of all tests shall be recorded in test reports containing the data necessary to prove compliance with the Technical Specifications and with these General Technical Requirements. The results of all tests shall be recorded in an approved format. Test certificates shall show the actual results and conditions of tests performed, the test circuits, oscillograms, etc.

All test certificates and reports shall be submitted to KAHRAMAA in Two (2) copies.

b) Test Program

The definite test program will be set out by the Contractor and approved by KAHRAMAA. Any tests to be performed during Commissioning are indicated in the Technical Specifications.

3.11.5 Performance Guarantee

The data indicated by the Contractor in the Technical Schedules and that required by Technical Specifications are regarded as guaranteed values.

The Contractor shall guarantee that equipment/system tolerances/performances shall not exceed the values specified in the appertained standards or in the other provisions of the Contract, or those indicated in the Technical Schedules and Technical Specifications.

If measured values of equipment/system performance are inferior to the ones indicated above, the Contractor shall with reservation to the other provisions of the Contract, be bound to modify the equipment/system, within a reasonable time, in order to achieve the guaranteed values.

If the guaranteed values cannot be achieved by means of modification, or if such modification is omitted by mutual agreement, KAHRAMAA reserves the right to reject such equipment/system or to accept the equipment/system in which case the Contractor shall pay a mutually agreed penalty to KAHRAMAA, unless otherwise indicated elsewhere in the Specification.

3.11.6 Third Party Investigations

In case of failure of any equipment/plant/system during installation, testing and commissioning or during operation within the warranty period, such failures will be investigated by KM appointed third party investigation agency/Consultants. If any of the equipment/plant/system provided under this contract does not satisfy the requirements of the specifications or the guaranteed performance, it will also be considered as failure of the respective item. The Contractor shall fully co-operate with the investigating agency in the manner required by them for proper completion of such investigations and shall bear full costs of such investigations. The investigating agency will submit their recommendations to KM which will be reviewed by KM. Consequently KM may refuse acceptance of the equipment/plant/system and require the same to be replaced or alternatively accept it with certain conditions, such as reduction in the Contract Price, extended warranty period etc. Contractors are obliged to abide by the Third-party Agency/Consultant's findings/recommendations and KM's decision. KM’s decision in this regard shall be final and binding to the Contractor.

3.12 Signs

3.12.1 General

Safety colors, safety symbols and safety signs must comply in construction, geometrical form, colour and meaning with the ISO Draft Recommendation 507 of the ISO Committee TC 80 "Safety Colours".

Signs of plant identification during the erection period must be to Employer's approval.

3.12.2 Material

The signs should be of a material which is weather-resistant and has sufficient longevity under the conditions prevailing on site.

3.12.3 Mounting and Installation

The position for the signs must be chosen so that they are within the field of vision of the persons to whom they apply. The signs should be permanently attached. Temporarily dangerous areas (e.g. construction sites, assembly areas) may also be marked by portable signs. The safety signs must be mounted or installed in such a manner that there is no possibility of misunderstanding.

3.12.4 Information Signs

Information signs should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment.
For example:

Floor numbers, load-carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification, etc.

In the choice of information signs for applications where nothing is specified by ISO Draft Recommendation 507 the possibility of using pictograms should be considered. Pictograms are particularly suitable for the identification of rooms, areas and buildings in the non-technical areas of the plant, sanitary and amenities buildings, etc.

3.12.5 Signs for Emergencies

In the event of accidents, all necessary information should be available immediately to those affected. Thus, a sufficient number of signs of appropriate size should be installed such as, for example:

escape routes (including marking of floor areas), emergency exits, fire alarms, fire extinguishers, instructions for special fire-extinguishing agents, warnings against fire-extinguishing agents (CO_2), first-aid equipment, first-aid points, accident-reporting points, telephone, etc.

3.12.6 Signs Obligatory

Signs for obligatory actions must be installed wherever certain action is necessary, for example:

Do not obstruct entrance, keep right, etc.

Signs to be obeyed should also indicate when the wearing of protective clothing and equipment is necessary, for example:

Protective goggles, protective clothing, helmets, head guards, breathing equipment, ear defenders, etc.

3.12.7 Warning Signs

Warning signs should refer to the existence or possible existence of danger, such as:
inflammable substances, explosive substances, corrosive or noxious substances, suspended loads, general danger, width/height restriction, danger of tripping, steps, slipping, falling, etc.

3.12.8 Prohibition Signs

Prohibition signs are as follows, for example:

No smoking; no fires; no naked lights or smoking; no entry to pedestrians; no entry; do not start, etc.

4. TECHNICAL PARTICULARS AND BASIC DESIGN CRITERIA

4.1 400kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 400kV
- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 420kV
- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 420kV
- Standard rated frequency : 50 Hz
- Fault level : 63 kA
- System configuration : 3ph.,effectively earthed
- Coefficient of earthing : 0.8
- Range of highest voltage for equipment
  (according to IEC 60071-1, Clause 5.8) : range II
- Basic Insulation Level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) : 1425 kV
  - Rated Switching impulse withstand voltage : 1050 kV
  - power frequency short duration withstand voltage (r.m.s)/60min: 630 kV
- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.2 220kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 220kV
- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 245kV
- Highest voltage for equipment

(r.m.s. phase to phase voltage) : Um = 245kV

- Standard rated frequency : 50 Hz
- Fault level : 50 kA
- System configuration : 3ph.,effectively earthed
- Coefficient of earthing : 0.8
- Range of highest voltage for equipment
  (according to IEC 60071-1, Clause 5.8) : range I
- Basic Insulation Level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) : 1050 kV
  - power frequency short duration withstand voltage (r.m.s): 395 kV
- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.3 132kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 132Kv
- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 145kV
- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 145kV
- Standard rated frequency : 50 Hz
-
- Fault level : 40 kA
- System configuration : 3 phase, effectively earthed
-
- Coefficient of earthing : 0.8
-
- Range of highest voltage for equipment
  (According to IEC 60071-1, Clause 5.8) : range I
- Basic Insulation Level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) : 650 kV

- power frequency short duration withstand voltage (r.m.s): 275 kV

- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.4 66kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 66kV

- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 72.5kV

- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 72.5kV

- Standard rated frequency : 50 Hz

- Fault level : 31.5 kA

- System configuration : 3phase, effectively earthed

- Coefficient of earthing : 0.8

- Range of highest voltage for equipment
  (According to IEC 60071-1, Clause 5.8) : range I

- Basic Insulation Level for equipment (B.I.L.)

  - rated lightning impulse withstand voltage (peak) :325 kV

  - power frequency short duration withstand voltage (r.m.s) :140 kV

- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.5 33kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 33kV

- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 36kV

- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 36kV

- Standard rated frequency : 50 Hz
- Fault level : 31.5 kA
- System configuration : 3 ph, non-effectively earthed
- Range of highest voltage for equipment
  (According to IEC 60071-1, Clause 5.8) : range I
- Basic Insulation Level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) : 170 kV
  - power frequency short duration withstand voltage (r.m.s) :70 kV
- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.6 22kV SYSTEM

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 22kV
- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 24kV
- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 24kV
- Standard rated frequency : 50 Hz
- Fault level : 31.5 kA
- System configuration : 3 ph, non-effectively earthed
- Range of highest voltage for equipment
  (According to IEC 60071-1, Clause 5.8) : range I
- Basic Insulation Level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) : 125 kV
  - power frequency short duration withstand voltage (r.m.s) :50 kV
- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.7 11kV System

The basic technical values have been determined in accordance with the recommendations of IEC 60038, IEC 60071-1, IEC 60071-2 and other relevant IEC publications.

- Nominal system voltage
  (r.m.s. value, phase to phase voltage) : Un = 11kV

- Highest value of system operating voltage
  (r.m.s. phase to phase voltage) : Um = 12kV

- Highest voltage for equipment
  (r.m.s. phase to phase voltage) : Um = 12kV

- Standard rated frequency : 50 Hz

- Fault level : 31.5kA

- System configuration : 3 ph, non-effectively earthed

- Range of highest voltage for equipment
  (According to IEC 60071-1, Clause 5.8) : range I

- Standard Insulation level for equipment (B.I.L.)
  - rated lightning impulse withstand voltage (peak) :75 kV
  - power frequency short duration withstand voltage (r.m.s) :28 kV

- Insulation Coordination in accordance with IEC 60071-1 and IEC 60071-2

4.8 Low Voltage AC and DC

The following basic technical values have been determined in accordance with the existing installations:

Low Voltage AC

- Nominal System Voltage : 415 / 240V
- Voltage variation max. : ± 6%
- System configuration : 3 phase, 4 wire
- Test voltage : 2.5kV (1 min.)

Low Voltage DC

- Nominal System Voltage : 110V ± 10%
- Capacity corresponding to a discharge time of : 10h
- Test voltage : 1.5kV (1 min.)

4.9 Control and Protection System

- Nominal measuring voltage : 110VAC
- Nominal measuring current : 1A
- Auxiliary Voltage : 110VDC

5. ELECTRICAL REQUIREMENT

5.1 Ambient Temperature

All electrical equipment and instruments for indoor installation shall be designed for continuous operation at an ambient temperature of 50°C.

Outdoor installations shall be suitable for ambient temperatures of at least 50°C. Moreover, temperatures directly under the sun shall be considered by additional temperature gain.

Apparatus and material in enclosed metal unit cubicles and switchboards shall be designed for operating temperatures in excess of the maximum internal temperature attained inside the enclosure during continuous full rating operation.

5.2 Motors

All motors shall comply with IEC 60034 and dimensions with IEC 60072. They shall be capable of operating continuously under actual service conditions without exceeding the specified temperature increases, determined by resistance, at any frequency between 48 and 51 Hertz together with any voltage between ±5 percent of the nominal value.
All motors shall be totally enclosed, and if situated in the open they shall be weatherproof and suitable for outdoor operation. They shall be provided with a suitable means of drainage to prevent accumulation of water due to condensation and with suitable means of breathing.

Motors shall have insulation to Class F standards for ambient temperature of 50°C. The temperature rise shall be restricted to that associated with Class B insulation. Where the motor may be appreciably affected by conducted heat the class of insulation shall be subject to approval.

All motors shall be suitable for direct starting at full voltage.

Motors shall have sealed ball or roller bearings.

The three line connections of a.c. motors shall be brought out to a terminal box. (Natural rubber insulation shall not be used). The terminal arrangement shall be suitable for receiving copper cable. Terminal markings shall be made in a clear and permanent manner and shall comply with IEC 60034. A diagram or instruction sheet shall be permanently attached giving the connections for the required direction of rotation. All terminal boxes shall be of the totally enclosed type designed to prevent penetration of dust and moisture and sealed from the internal air circuit of the motor. All joints shall be flanged with gaskets of neoprene or other approved material. Natural rubber insulation shall not be used. Explosion-proof motors shall be provided, where necessary. Where single phase motors are employed the motors shall be grouped so as to form, approximately, a balanced three phase load. Motors shall have suitable lifting arrangement. All the motors except motors related to fire protection shall have single phase preventer to block operation in case of loss of one phase.

5.3 Motor Control Gear

Control gear shall comply with the requirements of IEC 60947-4-1, the control gear being rated according to the duty imposed by the particular application.

Motor contactors shall comply with IEC 60947-4-1 class of intermittent duty 0-3 with type IP 52 enclosure protection and a utilization category AC4. They, and their associated apparatus shall be capable of switching the stalled current, and shall have a continuous current rating of at least 50 per cent greater than the full load current of the motors they control.

The operating currents of overload trips fitted to motor contactors shall be substantially independent of ambient temperature conditions, including the effect of direct sunlight on the enclosure in which the contactors are installed.

Where small motors are connected in groups, the group protection shall be arranged so as to operate satisfactorily in the event of a fault occurring in a single motor. The control and protection equipment shall be accommodated in the control cabinet or marshalling kiosk.

Each motor or group of motors shall be provided with a control gear for starting and stopping both manually and automatically. Short circuit, overload and single-phasing protection shall be provided.

5.4 Bushings and Insulators

Porcelain or glass insulators and bushings shall comply with the requirements of IEC 60137, IEC 60168, IEC 60273, IEC 60305 and IEC 60433, as applicable.

Porcelain for insulating purposes shall comply with the requirements of IEC 60672. Each porcelain insulator shall bear the manufacturer's mark and batch identification, which shall be applied before firing. The clamping surfaces of all porcelain insulators shall be accurately ground and shall be free of glaze.

Insulators and bushings shall satisfy the test requirements of IEC 60168, IEC 60233 or IEC 60383, as applicable. The design of insulators shall be such as to minimize the radio interference (RFI), and tests shall be made in accordance with IEC 60437, or equivalent, to limit RFI to CISPR of CCITT recommended limits, or equivalent National Standards or Regulations.

Insulators and bushings of organic, moulded or resin-bonded, material shall comply with the requirements of IEC 60660, as appropriate. They shall have a durable non-hygroscopic surface finish with a high anti-tracking index. Precautions shall be taken during manufacture and assembly of insulators of this type to exclude all moisture.

The Comparative Tracking Index (C.T.I.) shall be determined on all organic material insulators, and other insulating material, as directed by KAHRAMAA. The test method on any electrical materials, intended for use outdoors or in severe ambient conditions, shall be in accordance with IEC 60587, and materials, not exposed to such conditions, shall be tested in accordance with IEC 60112.

Insulators and bushings of moulded, or resin bonded material shall be identified with the manufacturer's mark and batch identification. Such marking shall not impair the electrical properties of the surface finish.

Insulators and bushings shall be mounted, and the method of attaching connections be such, that there is no likelihood of their being mechanically overstressed during normal tightening of the mounting and connection fixings. Similar provision shall be made to accommodate expansion and contraction of the connections having regard to the temperature likely to be attained during fault conditions. Mountings shall be of sufficient strength and rigidity to withstand the forces created by the passage of maximum prospective, short-circuit current with full asymmetry, without permanent damage or permanent

deflection sufficient to reduce electrical performance or insulation strength. The arrangement of all insulators and bushings shall be such as to minimize the accumulation of dust.

5.5 Cable Boxes and Glands

All cable boxes shall be suitable for cables entering from below. Cable boxes shall be dust, weather, rodent and insect proof, conforming to IP66 of IEC 60529 and shall be fitted with a suitable pressure relief device and dehydration breather.

They shall be fitted with disconnecting links to permit cable testing and shall have bolted inspection covers for each compartment to facilitate maintenance.

Resin oil filled boxes are not acceptable.

Gland plates shall be shall be of non-magnetic material and shall be earth bonded with cable box material.

Cable boxes shall be capable of withstanding on site the cable high voltage test level in accordance with IEC 60859, IEC 62271-203, IEC 60141 or IEC 60502, as appropriate.

The outdoor terminations shall be designed to withstand all atmospheric conditions due to weather, ozone, acids, alkalis, sandstorms or rapid changes of temperature under the working conditions existing at site.

The design shall be such that stresses, due to expansion and contraction in each part of the insulator and fittings, shall not lead to the development of defects.

The design of all terminations shall be such as to permit easy cleaning.

Where the cables are required to be terminated in power transformers, the Contractor shall be expected to provide full details of equipment into which the cables are terminated, in order to clarify the design and manufacture of the cable termination and its enclosure.

A separate earth terminal of adequate dimensions shall be provided on the main metalwork of all termination points.

The terminations shall be complete with suitable supporting and lifting arrangements.

When single - core cables are used, particularly for currents in excess of 500 A, adequate steps shall be taken to minimize the effects of eddy currents in the gland and bushing-mounted plate.

Gland plates for externally mounted marshalling boxes shall be in the form of removable gasketted steel plates, forming part of the underside of the box. Indoor marshalling boxes shall be fitted with gland plates on all four sides.
Cable glands for extruded solid dielectric insulated cables (PVC, EPR, XLPE) shall be of the double compression type, and as specified in BS 6121 Part 1.

All glands shall be provided with an earthing tab or equal facility. For cables having conductors not larger than 4 sq. mm., serrated washers may be used in place of earthing tags to provide earth continuity.

Glands for armoured or screened cables greater than or equal to 240 sq. mm. and all insulated glands for power cables shall be provided with an integral earthing lug.

Insulated glands shall be provided with removable connections for bonding across the gland insulation. The gland insulation shall withstand a wet insulation voltage withstand test of at least 2 kV a.c. for 1 minute (or the specified test voltage, whichever is the higher).

5.6 Cubicle Wiring

Cubicle connections shall be insulated with PVC to IEC 60227. Wires shall not be jointed or teed between terminal points. Bus wires shall be fully insulated and run separately from one another along the top or bottom of the cubicle. Fuses and links or miniature circuit breakers (MCBs) shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The d.c. trip and a.c. voltage supplies and wiring to the main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Control and alarm supplies shall be segregated as well. Each such group shall be fed through separate MCBs from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group.
Each wire connection within the cubicle shall be provided with clearly engraved identification ferrules showing source and destination on either side of the wire. The ferrules shall fit tightly to the wire and shall not fall off when the wire is disconnected from the terminal block. All wires associated with the tripping circuits shall be provided with red ferrules marked "Trip" in white. KAHRAMAA's practice of wiring numbering should be adopted throughout.

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

If single conductor is used it shall be annealed copper of circular cross sectional area of not less than 1mm^2. Flexible conductors of 1.5 mm^2 may be employed on indoor independently mounted control and relay panels.

Crimped connectors of approved type shall be used to terminate all small wiring.

When connections rated at 240 volt and above are taken through junction boxes they shall be adequately screened and "DANGER" notices shall be affixed to the outside of junction boxes or the marshalling kiosk.

All metallic cases of instruments, control switches, relays etc. mounted on control panels or cubicles shall be connected by copper conductors of not less than 4 mm^2 section to the nearest earth bar.

Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

5.7 Terminal Boards and Terminal Blocks

Terminal boards shall be of good quality non-flammable insulating material, with a comparative tracking index (CTI) of not less than 500, to IEC 60112.
Terminal boards shall be spaced not less than 100 mm apart and the bottom of each board shall not be less than 200 mm above the incoming cable gland plate. For relay panels, they shall be mounted at the sides of the cubicle, and set obliquely towards the rear doors to give easy access to terminations and to

enable ferrule numbers to be read without difficulty. Where plastic cable channels are used, a minimum space of 50 mm shall be left between channel and terminal boards.

For crimped type terminations, at least two sets of crimping tools must be supplied for each installation.

Terminals shall be of the insertion clamp type incorporating captive pressure screws, which do not bear directly on the wire but on a serrated clamping plate. The pressure screws shall have an inherent locking feature and terminal entries should be shrouded such that no current carrying metal is exposed.

Where connections are to be made between the multicore cables supplied and telephone type multicore cables, the terminal boards shall comprise of a clamp type terminal for the multicore cable joined by a withdrawable insulated link. These terminals shall also be provided with facilities for the insertion of test probes on both sides of the link.

Terminations shall be grouped according to function and labels shall be provided on the fixed portion of the terminal boards showing the function of the group. Terminals for connections that exceed 125V shall be separated from those of other circuits and shall be fitted with insulating covers.
The use of terminal boards as junction points for wires that are not required in the associated cubicle shall be avoided wherever practicable.

Terminal boards shall include short circuit and disconnecting links for CT circuits and disconnecting links for VT and other circuits as necessary and shall be suitable for the connection of test plugs.

No more than two wires shall be terminated on either side of a terminal. When it is required to terminate more than two wires on the same terminal, the wires shall be terminated on adjacent terminals and these terminals shall be shorted using suitable shorting links.

All spare contacts and terminals of panel mounted equipment and devices shall be wired to terminal blocks.

Each terminal block shall have a minimum of 20 percent spare terminals.

5.7.1 Moulded Case and Miniature Circuit Breakers and Fuse Links

All Moulded Case Circuit Breakers (MCCBs) and miniature circuit breakers (MCBs) shall be constructed to BS EN 60947.

For protection and isolation of circuits associated with protection control and instruments, miniature circuit breakers or fuses and links should be used, although miniature circuit breakers are preferred.

Miniature circuit breakers shall be designed and tested in accordance with IEC 60127 and supplementary requirements of this specification. They shall be suitable for use over the full range of expected voltage variation as specified in the Schedules.

They shall be suitably rated for both the continuous and short circuit loadings of the circuits they are protecting under all service and atmospheric conditions stated in the specification and ensure that correct discrimination is maintained between main and sub-circuits.

For three phase circuits, the miniature circuit breakers shall be of the three-pole type; for single-phase circuits they shall be of the single pole type and for d.c. circuits they shall be of the double pole type.

Where miniature circuit breakers are used in circuits containing inductive loads, e.g., operating coils, it is essential that they are suitable for satisfactory operation in the circuit in which they are used, i.e. account is taken of the circuit time constant.

All miniature circuit breakers shall be provided with auxiliary contact(s) for remote indication of circuit breaker operation.

Means shall be provided to prevent the miniature circuit breakers being inadvertently switched to the "OFF" position. Facilities shall be provided for 'locking-off' the miniature circuit breakers for isolation purposes.

Miniature circuit breakers shall be mounted in such a manner so as to give easily visible indication of breaker position and shall be grouped and spaced according to their function in order to facilitate identification and easy replacement.

Carriers and bases for fuses and links shall be in accordance with IEC 60269 and color coded to permit identification of the circuit rating.

The fuses and links mounted in cubicles for tripping circuits and protective gear test links shall be mounted on the front of the panel. Other links and fuses shall be accommodated within the cubicle or above the cubicle doors. Fuses and links shall be grouped and spaced according to their function in order to facilitate identification.

All incoming circuits in which the voltage exceeds 125V shall be fed through insulated fuses and/or links, the supplies being connected to the bottom terminal. The contacts of the fixed portion of the fuse or link shall be shrouded so that accidental contact with live metal cannot be made when the moving portion is withdrawn.

Main supply fuse links shall be of the high rupturing capacity cartridge type. Where fuse carriers are mounted vertically the incoming (supply) side shall be the bottom terminal. Where either fuses or circuits breakers are used it should be ensured that proper discrimination between main and sub-circuits is maintained.

5.8 Marshalling Kiosks and Junction Boxes

All outdoor boxes and kiosks shall be of sheet metal construction, formed on a framework of standard rolled sections, with a protection Class IP 65 of IEC 60529, shall be insect and rodent proof. All boxes which are mounted outdoors shall have sunshades with capability to work as rain protection shield.

Heaters shall be provided and shall be controlled by a watertight switch mounted externally. Ventilation louvers shall be provided and divisions between compartments shall be perforated. Heaters shall be controlled by suitable hygrostats and thermostats. They shall be suitable for operation with a 240V 50 Hz supply.
All cables shall enter boxes and kiosks at the base.

Each compartment of all kiosks and junction boxes shall be provided with access doors at the front and rear. Doors and access covers shall not be secured by nuts and bolts but shall be fastened with integral

handles with provision for locking. Door-actuated lighting should be provided inside the kiosk/junction boxes.
Kiosks doors shall be of the lift-off and hinged type and shall be provided with laminated glass windows of adequate size to facilitate reading of indicators from outside the kiosk. Where appropriate, facilities shall be provided to allow removal of temperature indicators without the need to pass the capillary tubing and bulb through the various compartments.
All hinged doors for marshalling kiosks, control cabinets, DBs, etc. shall be provided with stoppers.
For indoor installation, doors and covers under 15 kg mass may be of the slide-on pattern, but above this mass, hinged doors shall be used.
If three phase connections are taken through a box or kiosk, they shall be adequately screened or insulated and suitably marked with the phase color code; a danger notice stating the voltage shall be fixed on the inside and outside of the kiosk or box.
A durable copy of the circuit wiring diagram shall be affixed to the back of the kiosk door and labels shall be provided inside each kiosk or box to describe the functions of various items of equipment.

A watertight **BS 1363 socket outlet 240V AC 13 A** 3 pin interlocked switched socket with plug for a 240 volt AC supply shall be mounted externally on the marshalling kiosk. This switched socket shall be connected to the kiosk heater supply circuit through a 13 ampere fuse in the line lead. The earth terminal shall be earthed.

5.9 Degrees of Protection

The following degrees of protection shall be provided in accordance with IEC 60529.
For outdoor equipment, the degree of protection shall be IP 66.

For indoor applications where the equipment is housed in the same building as that enclosing water and steam operated equipment, the degrees of protection stated in the previous paragraph shall be uprated to IP 66.

5.10 Supply Voltage

All incoming supplies of greater than 125V to earth shall have their terminations shrouded by a suitable insulating material.

5.11 Ancillary, Multicore and Control Cable Installation

General

Outdoor cables shall be laid on cable trays within concrete cable troughs, drawn in ducts or laid direct in the ground, subject to the approval of KAHRAMAA.

Indoor cables shall be laid on cable trays or ladder racks.

On main cable routes, the disposition of cables shall segregate ancillary, multicore and control cabling, as far as is practicable.

Cable entries into buildings shall be via duct banks or cable tunnels and shall prevent the ingress of moisture, gases and vermin.

Where a conduit is used, the runs shall be laid with suitable falls and the lowest parts of the run shall be outside the equipment. All conduit runs shall be adequately drained and ventilated. Conduits shall not run at or below ground level.

Cable Troughs

For cable troughs, an appropriate drainage system shall be provided.

Trough covers shall be of reinforced concrete, designed to withstand the maximum loads to be encountered during installation and in service.

All cables installed in concrete troughs within a substation shall have suitable anti-termite protection, to be approved by KAHRAMAA.

5.11.1 Cable Trays

Cable trays shall be made of hot dip galvanized steel. When installed and loaded with cables the trays shall sag no more than 50 mm at midpoint between supports; the maximum space between supports shall be 3 meters. Open type cable trays shall be used for power and control cables. Cable density in trays shall not exceed 40 percent of the available tray cross sectional area (depth x width).

Cable trays arranged one above the other shall have a minimum separation distance of 250 mm between the top of the lower tray to the bottom of the next upper tray.
Where cables are installed on trays, or supported on steelwork, above ground level outdoors, stainless steel strapping shall be used for securing the cables. Plastic strapping may be used elsewhere.

The cable trays must be so designed that a reserve space of 20% remains free on all trays after laying of all the cables.

All cable tray T-junctions, crossovers, incoming and outgoing branches, etc. shall consist of prefabricated tray elements to ensure proper laying of the cables at the transition points and to avoid congestion.

The space between the individual cable trays and risers must be large enough to ensure that the power, instrument, control, measuring and signaling cables as well as the cables of the communication systems do not cause mutual interference.

All tray sections must be firmly bolted together to form a continuous metallic link end-to-end and shall be connected to the substation grounding system at least within 20 m intervals. If Power cables without metallic screen are laid in a cable tray then a continuous earthed conductor shall be provided along the run of the cable trays.

5.11.2 Direct-buried Cables

All cables laid direct in the ground shall be laid in an excavated trench, protected by reinforced concrete cable covers and PVC warning tapes and the route marked by above ground cable markers.

Reinforced concrete cable covers shall be precast and constructed in good quality cement with aggregate not exceeding 9.5 mm nominal size. The covers shall be efficiently compacted in the mould with the exposed face off level and have the ends designed to provide an interlocking facility to resist

lateral displacement after installation. The width of covers shall preferable be limited to 600 mm for easy lifting. After fabrication, the covers shall be subject to impact test as per BS 2484.

The top of the protection covers shall be at a depth not less than 450 mm below the surface of the ground and there shall be a layer of sand backfill 75 mm deep between the cable and the bottom of the trench and between the top of the cable and underside of the covers. Where cables in the same trench are laid over each other they shall be separated by not less than 75 mm of sand backfill.

Where cables are buried in the ground, cable warning tapes shall be continuously installed 300 mm directly above the cable tiles.

The tape shall have a thickness not less than 0.1 mm gauge, shall be 150 mm wide and manufactured from high-grade polyethylene pigmented in bright colors.
The warning message in Arabic and English, as per KAHRAMAA's standard, shall be continuously printed in a contrasting color in characters not less than 20 mm high, specially protected against deterioration and fading.

The tape shall be supplied in rolls on stout reels suitably cleated for shipment.
Above ground cable route markers shall be installed where the cable route changes direction and at both ends of road crossing ducts. Route markers shall be installed at a maximum distance apart of 50 meters on straight runs of the cable route. The position of route markers shall be clearly indicated on the route plans.

Direct-buried cables will be inspected by KAHRAMAA before the trenches are backfilled.

5.11.3 Solar Radiation Protection

Where cables are installed in positions exposed to direct sunlight, suitable solar-shields shall be fitted. These shall be designed to protect the cables from direct sunlight and to maintain air circulation. The design of the solar shield shall be subject to approval of KAHRAMAA.

5.12 Termination of Cables and Wires

The Contractor shall provide fully detailed wiring diagrams covering all parts of the plant. Detail diagrams shall be cross-referenced and shall show multicore cable schedule reference numbers to facilitate cable identification. Cable schedules listing all cables and their points of termination including details of cable, number of cores, core reference, core size, number of cores in use and cable length, etc. shall be provided for each substation.

Multicore cable tails shall be so bound that each wire may be traced to its cable without difficulty. The spare cores of all multicore cables shall be numbered, terminated and earthed at a terminal block in the cubicle. The spare cores shall have sufficient length to allow re-termination on any terminal block in the cubicle. Where cables are terminated in a junction box and the connections to a relay or control cubicle are continued in conduit the spare cores shall be taken through the conduit and terminated in a cubicle. The d.c. trip and a.c. voltage circuits shall be segregated from those for back-up protection.

All incoming and outgoing connections shall be terminated at a terminal block. Direct termination into auxiliary switches or relays will not be accepted. Terminals of relays, auxiliary switches, etc. shall not be used as junction points.

The screens of screened pairs of multipair cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagram.

All wires on panels and all multicore cables shall have ferrules that bear the same number at both ends. At those points of interconnection between the wiring carried out by separate contractors where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment. The same ferrule number shall not be used on wires in different circuits on the same panels.

Auxiliary PVC insulated cables shall be terminated with compression type glands, clamps or armour clamps complete with all the necessary fittings.

All cables shall be identified and shall have phase colors marked at their terminations where appropriate. Where cables leave the apparatus in an upward direction the cable boxes shall be provided with a barrier joint to prevent leakage of cable oil or compound into the apparatus.

5.13 Auxiliary Switches

With each circuit breaker, disconnector, contactor and earthing devices, there shall be supplied all necessary auxiliary switches and mechanisms for indication, protection, control, interlocking, supervisory and other services as specified.

Where appropriate, auxiliary switches shall be suitable for light current, low voltage applications.

The contacts of all auxiliary switches shall be strong and be capable of adjustment in relation to the movement of the circuit breaker or other item of plant.

Not less than four spare auxiliary switches of each type shall be provided.

All auxiliary switches shall be wired up to a suitable terminal board on the fixed portion of the switchgear whether they are in use or not in the first instance, and shall be arranged in the same sequence on all similar items of equipment.

Switches shall be provided to interrupt the supply of current to the tripping mechanism of the circuit breakers and latched contactors. All such switches and mechanism shall be mounted in accessible positions clear of the operating mechanism, and shall be adequately protected.

5.14 Earthing

Connections by a secondary conductor of an approved section shall be made from the earth terminal of each item of equipment to the system earth. Where necessary, or as required by KAHRAMAA, the earthing conductor shall be suitably cleated. All earthing conductors shall be made of copper.
No drilling of the earth conductor shall be allowed except in the jointing or terminating work unless agreed with KAHRAMAA.

All metal parts, other than those forming part of any electrical circuit, shall be connected to the main earth system by means of a hard drawn high conductivity copper earth bar with a cross sectional area such that the current density is not greater than 200 A/mm^2 for 1 second fault durations and 115 A/mm^2 for 3 second fault durations with a minimum of 30 mm^2.

The substation earthing shall comply with IEEE 80.

If an earthing conductor is required to be installed along the same route as the cable the copper conductor shall have a cross-sectional area not less than 30 mm^2. The earthing conductor shall be connected at both ends to the main system earth or shall act as the main system earth connecting transformer neutral points and various items of equipment. The earthing conductor, when installed as the main system earth shall be the same size of the main system earth and shall be able to carry any prospective fault current.

Earth conductors laid direct in the ground shall be lead covered, with a minimum thickness 2 mm. The trench for these conductors shall be lined and backfilled with fine top soil or clay.
Joints shall have a resistance not exceeding that of the equivalent length of the conductor, and KAHRAMAA may require any joint to be tested to prove compliance with this requirement as well as the jointing technique adopted to seal the lead covering.
No flat earthing conductor shall be drilled with a hole larger than 13 mm diameter clear for attachment to the apparatus earth terminal; where holes larger than this are required a suitable tab shall be fitted to the end of the conductor. At any other point no hole larger than 6 mm diameter shall be drifted in any earth strip.

Connections shall be protected where necessary against electrolytic action and shall be made between clean surfaces and under sufficient pressure to prevent burning caused by fault currents. Joints shall preferably be made by low temperature bracing or crimping. Where bolted joints are used in copper connections they shall have the joint faces tinned.

All main members of structural steelwork shall be earthed by copper connections bonded to the steelwork at two locations and the lower arcing horns of outdoor type cable terminations shall be directly bonded to the main earthing system.

Connection to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected as appropriate against electrolytic corrosion. They shall be made between clean surfaces of sufficient size and pressure to carry the rated short circuit current without damage.

Power terminal studs rated for full system fault rating shall be provided at a convenient height (at the base of structure) to permit the attachment of portable earth connections for maintenance purposes.

The terminal studs shall be connected to the main earthing system via lead sheathed bond of approved design.

All large equipment shall be double earthed at two opposite locations. Wherever number of panels is installed together, appropriately sized grounding conductor shall run through the panels to connect earth point of each panel with the grounding conductor and both ends of grounding conductor shall be directly connected with indoor grounding grid. In case number of panels installed together is eight (8) or more than from every sixth (6) panel the earth bar shall have one additional connection to the indoor grounding grid.

All non-current carrying metal parts of electrical equipment shall be bonded to an earth terminal or terminals mounted on the equipment and readily accessible and shall be connected to the main earthing system.

All equipment terminals, provided for an external earth connection, shall be identified by indelible means unless such terminals are directly and visibly mounted on metallic equipment frames or earth bars, when such marking may be omitted.

Identification marks for earth terminals shall comprise the colors green/yellow in combination or a reproduction of the symbol no. 5019 in IEC 60417.

The size of the copper earth bar in control panels, control desks or similar enclosures containing low voltage apparatus, shall be such as to comply with the specified requirements for withstanding prospective short-circuit currents. The size of this bar shall, in no cases, be less than 100 sq. mm. cross-sectional area, providing that sufficient mechanical integrity is provided by adequate supports and terminals, and also, providing this size is not less than the size of the largest incoming power supply conductor.

The body of all relays shall be earthed using braided copper. Special consideration shall be given to the electronic earthing of static and numerical relays. The earth wires used for body earthing of panel mounted equipments shall be color-coded (green and yellow).

6. MECHANICAL REQUIREMENTS

6.1 Nuts and Bolts

All nuts and bolts, studs, screw threads, pipe threads, and bolt heads shall comply with the appropriate national standards for metric threads, or the technical equivalent.

All nuts and bolts which need to be disturbed during routine maintenance and which are directly exposed to weather shall be of stainless steel. Galvanized nuts, bolts, etc. are acceptable for structural steelwork, only. Where circulating currents need to be avoided insulated stainless steel bolts & nuts shall be used.

For mechanical reasons, current carrying terminal bolts or studs, except for small wiring, shall not be less than 6 mm in diameter.

All nuts and pins shall be adequately locked.

Wherever possible, bolts shall be fitted so that in the event of locking failure, resulting in the nuts working loose and falling off, the bolt will remain in position.

All nuts, bolts, and washers placed in outdoor positions shall be of stainless steel (except those on steel structures).

Where bolts are used on external horizontal surfaces where water can collect, the ingress of moisture to the threads shall be prevented.

Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

Spring washers shall be provided where necessary.

6.2 Galvanising

All steel works, unless otherwise indicated, shall be hot dip galvanized.

All galvanizing shall be applied by hot dip process and shall comply with BS EN ISO 1461 but shall not be less than 0.61 kg/m2. The minimum average coating weight on steel sections 5 mm thick and over shall be 0.915 kg/m2.

All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to galvanizing. Preparation for galvanizing and the galvanizing itself shall not adversely affect the mechanical properties of the coated material.

The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads. All nuts shall be galvanized.
Surfaces which are in contact with oil shall not be galvanized or cadmium plated.

Partial immersion of equipment will not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

Galvanizing of wires shall be applied by the hot dip process and shall meet the requirements of BS EN 10244-2:2001.

6.3 Aluminium and Aluminium Alloys

Aluminum shall be of the highest purity commercially obtainable and the Contractor shall submit certificates of analysis giving the percentage and nature of any impurities in the metal used.

Aluminum alloy casings shall be sound and non porous.

Aluminum alloys shall be of approved compositions and the Contractor shall submit certificates of analysis for the various parts.

Unless otherwise approved, aluminum or aluminum alloys shall not be used for encasing any current carrying parts in compound, oil filled chambers or valves.

6.4 Painting

The Contractor shall be responsible for all painting, both in the Works and on Site, of all pipe work, plant, equipment and steelwork included in the Specification including the supply of all materials, equipment, scaffolding and all other requirements for the painting of the Works.

The requirements regarding whether final painting shall be carried out by the Contractor in the Works or on Site depend on the facilities afforded in the Works and other reasons. The Contractor shall therefore submit to KAHRAMAA, for approval, his proposed painting procedure implementing the specifications for painting included herein.

6.4.1 Works Processes

The following specifications cover the various surface treatments for items which may be required to be painted or treated in the Works and on Site.

A1. Blast clean to BS 7079 Second Quality (SA 2.5), ISO equivalent or technically equivalent USA Standard to a profile of 25-50 micron and thoroughly clean all surfaces in preparation for the application of paint or sealer.

A2. Pre-treatment using an approved proprietary chromate / chrome phosphate immersion process.

A3. Blast clean to BS 7079 (First Quality), ISO equivalent or technically equivalent USA Standard and thoroughly clean all surfaces in preparation for the application of paint or sealer.

B1. Apply two coats of two-pack epoxy primer by airless spray application.

B2. Apply one coat of two-pack epoxy primer by airless spray application.

B3. Apply a primary coat of two-pack epoxy primer by airless spray application to an application thickness of 50 micron. Apply a two-pack epoxy/phosphate intermediate coat to an application thickness of 100 micron.

B4. Apply a two-pack epoxy/phosphate intermediate coat to an application thickness of 30 micron.

C1. Apply a finishing coat of two-pack polyurethane paint to a total overall application thickness of 80 micron.

C2. Apply a finishing coat of two-pack polyurethane paint to a total overall application thickness of 195 micron.

D. Remove any deteriorated or otherwise faulty or damaged existing paint down to bare metal by mechanical cleaning and make good with the existing type of paint, then paint with one coat of the existing type of paint overall.

The following Schedule indicates, for each item of equipment that is to be painted, the required treatment and their order of application. Any specifications not referred to in these requirements will be approved as necessary during the course of the Contract.

Equipment	**Specification**		
GIS (exterior), Local Control Cubicles - RAL 7038	A2	B2	C1
Transformer tanks (exterior) - RAL 9002	A1	B3	C2
Transformer tanks (interior)	A3	B4	
11kV Switchgear Panels - RAL 7044	A1	B1	C1
Control/Relay Panels, LVAC & DC Boards - RAL 7032	A1	B1	C1

Equipment	**Specification**		
Structural steelwork, oil and water pipes, tanks, exterior steel floors, galleries, stairs.	A1	B1	C1
Pumps/motors	A1	B1	C1
Ductwork	A1	B1	C1

In carrying out the cleaning, painting and marking of the equipment, the following general requirements shall also be taken into account:

All paints shall be applied in strict accordance with the approved paint manufacturer's instructions, regarding the correct drying times between coats, preparation of surfaces between coats, mixing of paints, suitable temperatures for application. No paints shall be applied to surfaces which are not completely dry.

Where employed, galvanizing shall be to a surface density of at least 0.61 kg/m^2. Where the galvanized surface is rendered discontinuous for any reason, the un galvanized surface shall be thoroughly cleaned to bright metal and painted with two coats of epoxy based zinc rich primer, two pack type, or to the requirements of BS EN ISO 1461.

Gauge and control panels shall be stove enamelled and the Contractor shall submit to KAHRAMAA his proposed stove enamel specification for approval.

All bright or machined parts or surfaces shall be protected during the processes of cleaning and priming surrounding metalwork and shall be coated with lanolin or other equal and approved compound which can easily be removed with white spirit after erection and testing on Site.

Any surfaces of metalwork and especially pipe work subject to condensation on the outside which may cause damage to other plant by dripping water shall be painted with one coat of an approved anti-condensation paint over the finished paints included in the relevant specifications.

All paints shall be of a type and make to the approval of KAHRAMAA and shall be applied in clean and dry conditions and in strict accordance with the paint manufacturer's instructions.

\No epoxy two pack painting system shall be applied where the ambient temperatures are less than 10°C.

All welds shall be blast cleaned prior to the application of any paint.

Any surfaces of metalwork encased in concrete shall not be painted.

All surfaces of structural steelwork which are bolted or riveted together shall be shot blasted and prime painted prior to assembly.

Plant identification shall be carried out as required by KAHRAMAA.

All final painting shall be carried out to conform with a colour schedule in accordance with KAHRAMAA's requirements.

All surfaces which are inaccessible after fabrication shall be completely painted in the Works prior to fabrication.

All cleaning and painting operations shall be carried out by skilled operatives. Workmanship shall be of the highest class. KAHRAMAA reserves the right to refuse or have renewed any preparation or painting which he deems to be substandard. All remedial works necessitated by mechanical damage or deterioration of the existing paint shall be carried out in accordance with Specification D.

Application of paints may be carried out by airless spray or by brush depending on the type of material to be applied. No other methods of application shall be adopted without prior approval of KAHRAMAA.

Any items or surfaces of plant and equipment not specifically mentioned herein shall be painted in accordance with the specification for the associated main plant involved.

Any apparatus and fittings that require matched assembly at Site shall be identified by distinguishing marks on them in accordance with the Contractor's standard code provided that no repetitions are occasioned thereby. These marks shall be located on two places. Galvanized or metal-sprayed parts shall be marked before metallizing. All marks shall be legible and visible.

The Contractor shall leave all paintwork clean and perfect on Take Over of the Works, implementing Specification D.

6.4.2 Paint schedule

The Tenderer shall supply his intended painting schedule with the Tender.

6.4.3 Variations

Variations to the above specified painting schedule may be permitted at the discretion of KAHRAMAA. Where these variations are submitted they should be based on the ISO EN 12944 standard. The coatings offered should be for use in an environment with an atmospheric corrosivity defined as "C5-M very high (marine)". The durability of the required coating shall be classified as "High Durability" (>15 years).

6.5 Oil

Sufficient insulating oil shall be supplied for the initial filling of all oil filled portions of the equipment.

6.6 Lubrication

Bearings which require lubrication either with oil or grease shall be fitted with nipples.

Grease lubricators shall be fitted with nipples complying with BS 1486 (or equivalent). Where necessary for accessibility, the nipples shall be placed at the end of extension piping. The Contractor shall supply at least one grease gun for each type of nipple provided. Where more than one special grease is required, a grease gun for each special type shall be supplied and permanently labelled.

6.7 Padlocks and Key Cabinet

Non-ferrous padlocks with stainless steel shanks with different key changes and two keys for each lock and bay-wise submaster as per standard practices of KAHRAMAA shall be provided.

Wall mounted lockable cabinets for the accommodation of padlocks and keys, whilst not in use, shall be provided and labeled in an approved manner so that keys can be easily identified. Duplicate keys shall be mounted in a separate cabinet.

For extensions/modifications to existing substations, the prevailing "master/ submaster" system shall be matched. Control room doors and gates of the new substations shall be fitted with locks to suit the master series of existing substations. New substations shall be provided with key changes to suit the submaster series bay-wise. No grandmaster for each substation is required. Submaster series keys shall be locked off in a separate cabinet. All padlocks and keys shall be engraved with proper identification numbers e.g., circuit number, equipment number, etc. as per KAHRAMAA standard numbering scheme. Locking facilities shall be such that it will accept sizes of padlocks & keys large enough to permit identification numbers, etc. to be embossed on them. Equipment shall be such that it can accept interlocks/scheme identical to that in existing substations.

7. INSTALLATION REQUIREMENTS

7.1 General

The Contractor shall perform all work in connection with the assembly and installation of the supplied equipment, including all accessories according to the Contractor's approved drawings and written instruction manuals. The written instruction manuals may be used as a general guide and may be modified or supplemented by the Contractor's Representative provided KAHRAMAA's approval is obtained. The Contractor shall submit a detailed procedure for the assembly and installation of his equipment within the period as indicated in Section 3.3.4.

The Contractor shall employ and maintain at the Site a sufficient number of experienced staff to organize, supervise and to carry out and complete the Works and provide all erection labour, tools and equipment, materials, temporary bracing and scaffolding required for the completion of his work.

7.2 Site Accommodation and Storage

7.2.1 Site Accommodation

The Contractor shall provide an area of the site away from the working areas for the erection of his site facilities. These areas will be available for restricted periods only and where due to the reasonable requirements of KAHRAMAA it is necessary for the facilities in these areas to be transferred to other areas, the Contractor shall at his own expense carry out the transfer upon a request to do so.

The Contractor shall ensure that the areas shall be reasonably levelled and shall have rainwater drainage and road access. Proper facilities shall be provided such as sanitation, telephone (landline

facility) & regular pest control should be carried out in order to ensure that the site accommodation offices are in clean & hygienic condition at all times.

7.2.2 Site Storage

The Contractor shall arrange temporary storage facilities at his own cost. All methods of storing and protecting items of plant on the Site shall be subject to KM prior approval & all such inspections should be carried out in coordination with KM/Consultant before storing any materials at site temporary Storage facilities.

The Contractor shall arrange, at his own expenses, for the covered storage and/or protection of all materials against corrosion and mechanical damage during storage and erection on the Site. Equipment stored at the Site shall be placed on timber or another approved material so that it is not in contact with the ground.

Security of all storage areas shall be the Contractor's responsibility and at the Contractor's expense.

Materials shall be handled and stored in a manner which will ensure that reasonable access is maintained to them, to facilitate inspection and checking of such materials and all works being executed at the site.

The Contractor shall, from time to time, as requested by KAHRAMAA, remove and replace selected sections of the protection provided for materials, to permit check inspections of materials delivered to and stored at the Site, to enable effective cleaning and to ascertain protection. Where any protection is found to be inadequate, all foreign matter and corrosive products present shall be removed, the internal or external surface cleaned to the approval of KAHRAMAA and adequate protection provided by the Contractor.

7.2.3 Storage Facilities (Warehouse & Storage Yards)

The Contractor shall arrange permanent storage facilities at his own cost in the form of Warehouses & Open Storage Yards depending upon the materials & equipments which are to be stored for the project. All methods of storing and protecting items of plant on the Site shall be subject to KM prior approval & all such inspections should be carried out in coordination with KM/Consultant before storing any materials at Storage Facilities (Warehouse & Storage Yards). It must be noted that this arrangement is mandatory which should be finalized by the EPC contractor immediately after the award of the contract and accordingly this should be notified to KM/Consultant for inspection.

It should be noted Substation Equipments & Materials should not be stored at construction sites in open areas. As per KM requirement, all equipments & materials for the project should be stored only in the KM approved dedicated warehouses or storage yards & no modification shall be worked upon unless otherwise approved by KM. Necessary fire and safety guidelines for storing the materials/equipments shall be followed at the above places. Any material found stored outside the approved storage yard is not acceptable and the inspection of the materials will be carried out only at the approved storage location.

All permanent Warehouses proposed should be certified by local Qatar Civil Defence Department (QCDD) & further Fire Protection System should be tested & certified by the authorized third party

contractors who are approved from QCDD. Regular maintenance inspections should be carried out by the third party & such maintenance records shall be available.

Also please note that the following SAFETY requirements shall be followed at your Storage Facilities.

- All Storage facilities shall be guarded by adequate no. of security personnel and all security staff to be trained in first aid and fire fighting. Training documents shall be made available during KM/Consultant inspection.
- Adequate lighting facility shall be provided as and where required.
- Hot works like gas cutting, welding or grinding etc. to be strictly prohibited or carried out with prior permission of client/consultant.
- Cable drums to be stored on end or secured blocked to prevent rolling.
- Fire gap shall be maintained as and where necessary.
- All emergency exits to be clear of any source of obstruction at all times. Storage shall not be stored within one meter of a fire door opening.
- Clearance shall be maintained around lights and heating surfaces to prevent ignition of combustible material.
- Adequate no. of portable fire fighting equipment shall be provided and maintained. Fire extinguishers shall be kept in easily accessible and visible places & it should not be obstructed at any time.
- Safety signs including No Smoking, No Naked Light, Exit, and Wear PPE', Emergency Contact Nos. etc. shall be displayed as and where necessary.
- All sources of flammable material shall be stored very carefully and strictly as per the Material Safety Data Sheet - MSDS instructions which shall be available for all such flammable storage materials.
- Emergency plan to be prepared for the storage facility and displayed at strategic locations.
- Compressed gas cylinders like SF6, Nitrogen etc. to be stored in approved safe place where they cannot be knocked. Gas cylinders shall be kept away from all flammable or combustible materials.
- High standard of housekeeping to be maintained at storage facility.
- In warehouse, material stored should be arranged such that the weight is evenly distributed and it should be ensured that heavy materials are not stored at the topmost locations of the racks.
- All chemicals shall be stored in approved safe, dry, ventilated area protected from extreme temperature and source of ignition. Material Safety Data Sheet - MSDS shall be available for all such chemicals stored.
- The storage facility shall be kept free from accumulation of unnecessary combustible material & no combustible material shall be stored outdoor far away from adjacent structure or portcabin.
- Wood, cartoon and packaging and other combustible materials shall not be accumulated inside warehouse or temporary sheds and shall be daily disposed of.
- Diesel to be stored in suitable metal containers and kept in adequately ventilated shed and with dyke wall around the storage containers. Volume of dyke wall shall not be less than 110% of the diesel container.
- Electrical connections to be done by trained and authorized electrician only. The supply to the air conditioners shall be routed through circuit breakers.
- All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition and that they will serve their purpose in time of emergency.

- Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

7.3 Transport and Handling of Material at Site, Crane Facilities

The Contractor shall be responsible for unloading, safekeeping, handling and storage of all his equipment and materials at Site.

The Contractor shall provide all necessary lifting and transport equipment for handling of all materials supplied to his storage space and from the storage space to the installation site. If additional handling equipment is required for site installation, the Contractor shall provide this.

The Contractor shall ensure that the Crane operator should have valid Qatari driving license and competency certificate from third party. Similarly, the Crane should have valid third party test certificate and further all construction related equipment/vehicles operators should have valid Qatari driving license and competency certificate from third party for the particular application. Also all the loading & unloading activities should be carried out only by trained & certified riggers.

7.4 Site Construction Supplies

It shall be the Contractor's responsibility to arrange site construction power and water supplies at his own cost, whether or not these are available at existing installations/substations.

KAHRAMAA may, however, permit the use of available power supplies for testing purposes only. Prior consent shall be obtained in writing from KAHRAMAA in this regard. KAHRAMAA's supply is normally 415 / 240V 3 phase 4 wire 50Hz and the Contractor should provide the necessary transformation to suit his plant requirements.

Such transformers shall be of an approved type having the mid-point of the secondary winding earthed in the case of single phase transformers and the star point of the secondary winding earthed in the case of the three phase transformers.

KAHRAMAA, while endeavoring at all times to maintain existing supplies for test purposes, accepts no responsibility for the consequences of any failure or cessation of the above supplies.

The Contractor will be responsible for providing and maintaining the whole of the installation including that part situated on the load side of KAHRAMAA's points of supply. All precautions that are necessary or desirable to ensure the safety of every person on the Site shall be taken. The Contractor's installation must satisfy KAHRAMAA or his authorized representative who may require the disconnection or alteration of any parts that he considers to be dangerous.

Such installations must comply with all appropriate statutory requirements and with the Regulations for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers (current issue) and the IEE wiring regulations. Unless specific instructions to the contrary are given by KAHRAMAA or his authorized representative, the following shall also apply:

a) All cables or conductors that may normally have applied to them a voltage to earth exceeding 65V must be enclosed in a metallic sheath that is continuous and is effectively earthed.
b) All cables and conductors which may have applied to them a voltage to earth exceeding 25V but not normally exceeding 65V shall, unless they are enclosed in a metallic sheath which is continuous and is effectively earthed, be covered with insulation and tough rubber sheathing having thicknesses not less than those set out in IEC 60245.
c) All hand lamps shall be arranged for 25V use and adequate precautions shall be taken to prevent 25V system or apparatus to become live from any higher voltage system.
d) Portable electrical hand held tools and light mobile apparatus shall not be used at any higher voltage than 110V. Double pole switching shall be used for apparatus connected to the 110V system.
e) Electrical heaters or radiators having exposed heating coils or elements shall not be used on the Site.

As soon as any part or the whole of the Contractor's installation is no longer required for carrying out the works the Contractor shall disconnect and remove the same to the satisfaction of KAHRAMAA or his authorized representative.

Any plant and apparatus used for electric welding shall comply with the appropriate National Standard and shall be to the satisfaction of KAHRAMAA.

The Contractor shall, unless otherwise specified, make all his own arrangements at his own expense for:

1. Telephone and other means of communications (VHF/UHF radio equipment-base stations, mobile and hand-held stations or similar) for the needs of construction within construction site and corresponding approvals from local authorities, and
2. Telephone, fax, telex and other communication from the Contractor's construction office and the Contractor's camp to the country's networks.

7.5 Medical Facilities

Provision for the medical needs of all working personnel at Site is the responsibility of the Contractor.

The Contractor shall provide and maintain all necessary First Aid equipment at the Work Site. At least, one of his staff shall be fully qualified in the administration of first aid.

7.6 Installation and Checking of Works

All works on Site shall be carried out in such manner as not to obstruct the operations of any other contractor on Site or the operation of existing plant. The Contractor shall submit to KAHRAMAA for review and approval, his proposed erection procedures and particulars of his proposed temporary works.

As each part of the Contract works is erected it shall be submitted to KAHRAMAA for approval. Prior to erection the Contractor shall ascertain from KAHRAMAA's inspector which part he wishes to inspect and approve, from time to time. However, such approval shall in no way relieve the Contractor of any of his obligations under the Contract. The Contractor shall prepare records on all major checks and measurements.

KAHRAMAA will provide major centre lines and datum levels only. The Contractor shall be responsible for transferring those required to carry out the works in accordance with the Contract Documents.

The Contractor shall employ, at his own cost, a competent surveyor for all setting out of datum lines including the continuous checking ;9and maintenance of the setting-out until the completion of the works.

The Contractor shall provide all necessary pegs, profiled templates and centre lines, and shall establish all such permanent markings and recovery marks as may be required by KAHRAMAA for checking the Contractor's setting out. The Contractor shall be responsible for rectifying, at his own cost, all work rejected by KAHRAMAA because of errors in setting out.

All bench marks, kerb marks, pegs and signals on the surface, alignment pins and the like put in by KAHRAMAA for the purpose of checking the Contractor's work or in the nature of permanent survey marks, will be under the care of the Contractor during the period of the Contract. He shall, at his own expense, take all proper and reasonable precautions and care to preserve and maintain them in their true position where such marks are within or adjacent to his work area. In the event, however, of their being disturbed or obliterated by any cause whatever, they may, if deemed necessary by KAHRAMAA, be replaced at the Contractor's expense.

Where pipe work and/or cables are installed underground, the Contractor shall provide at each change of direction point and at intervals of no greater than 30 m along the route, surface markers of a readily identifiable and easily distinguishable nature. Different designs of route markers will be required to suit (a) unmade ground, (b) paved areas and (c) landscaped areas. These markers shall indicate the directions and functions of the services.
Rust on the metal surfaces, shall be removed and oil and dirt on the surface on the parts to be embedded in concrete shall be polished and cleaned thoroughly before installing.

Before putting any section of work into operation the Contractor shall satisfy himself as to the correctness of all connections between equipment supplied under this Contract and equipment supplied under any other contract and shall give the period of notice as specified in the General Conditions of Contract Clause "Tests on Completion" when the equipment are ready to be energized.

The Contractor shall be deemed to have allowed such hours per week for working at the Site as are consistent with completing the Contract Works in the time specified and of a level comparable with that for similar classes of work being carried out on the Site.
If it appears to KAHRAMAA that the Contractor will be unable to complete any section of the Contract Works in the time stipulated then the Contractor shall, if required by KAHRAMAA, increase the number of personnel or carry on such work outside of normal working hours and shall not claim any extra expense thereby unless in the opinion of KAHRAMAA the delay is due to causes for which the Contractor would be entitled to an extension of time under the Conditions of Contract.

If KAHRAMAA shall certify that defects have appeared in the Works, the Contractor shall, for the purpose of fulfilling his obligations under the warranty provided for in the Conditions of Contract, arrange to clear the defects as soon as possible and in the case of an emergency shall depute necessary staff within forty-eight (48) hours of notice.

If KAHRAMAA certifies that defects have appeared in the Contract Works, the Contractor shall, during the warranty period after completion of the Contract Works provided by the Conditions of Contract, send to or keep on Site supervisory staff of such numbers and for such periods as KAHRAMAA may require.

7.7 Foundation and Grouting

Concrete foundations will be provided by the Civil Subcontractor to the required levels and dimensions to receive grout and base or bed plates. All scabbling to a depth of 13 mm and grouting in of plant, grillages and steelwork, adjustment to foundation levels, grinding of foundations, bedding on foundations, shall be carried out by the Contractor.

The Civil Subcontractor will finish all concrete foundations of dressed formwork to vertical faces and with steel float to horizontal faces. This will include the filling in of steel base plates and other pockets in which air and/or water could collect so that cleaning around the plant can be easily carried out.

For equipment supplied under the Contract, all foundation bolts and packing plates between the concrete and the equipment, bases and grillages shall be supplied by the Contractor.
During construction of the foundation, the Civil Subcontractor shall make provision for the setting of foundation bolts or other fixtures included in the Contract works and proper and sufficient drawings and templates and all material required to be built into or otherwise affecting any foundations, duct, pipe and trench shall be provided by the Contractor in time to avoid delay in carrying out the work. In any case, however, the Contractor shall check the position of any inserts and will be responsible for the correct setting.

7.8 Maintenance and Clearing of Site

The placing of materials and plant near the erection site prior to their being erected and installed shall be done in a neat, tidy and safe manner and so that the materials shall not be impaired by the elements or interfere with the normal operation and maintenance of the system. The Contractor shall at his own expense keep the site area allocated to him and also the erection area of the Contract Works reasonably clean and shall remove all waste material as it accumulates and as directed by KAHRAMAA from time to time.

7.9 Responsibility for the Running of Plant by Contractor

The Contractor shall instruct KAHRAMAA's operating staff in the recommended method of operation of the plant supplied.

If KAHRAMAA shall so require, the Contractor shall lend the services of a skilled Engineer acquainted with the running of the plant for any period required by KAHRAMAA between commencing to use any portion of the plant (whether taken over or not) and the expiry of the period of warranty, the wages for such services being paid by KAHRAMAA to the Contractor, except in respect of the carrying out of any work in which the Contractor requires his services for the discharge of the Contractor's obligations under this Contract.

7.10 Work at Time and Material Rates

If the Contractor is required to carry out work at time-and-material rates, KAHRAMAA will furnish the Contractor with such particulars as are necessary to enable the Contractor to prepare detailed drawings and schedules of all such work.

All work at time-and-material rates shall be paid for in accordance with the rates stated in the Schedules.

Work shall not be carried out on a time-and-material basis without KAHRAMAA's written consent. He shall order such work only after obtaining the necessary approval from KAHRAMAA. When this work is in progress the Contractor shall render day-work sheets to KAHRAMAA in one week from the

commencement, showing the number of men so employed with the number of hours worked and the detailed quantities of materials used. The Contractor shall obtain KAHRAMAA's certification of the day-work sheets at the time such work is carried out and failure to do so shall render the Contractor liable to forfeit payment.

All applications for payment for such work by the Contractor shall be accompanied by statements authorizing the carrying out of such work, duly signed by KAHRAMAA and shall be submitted within one month of the completion of the work.

7.11 Documents, Goods, Materials to be Handed Over to KAHRAMAA

In addition to the relevant requirements of the General Conditions of Contract, the Contractor shall obtain a signed receipt by an authorized representative of KAHRAMAA for all documents, goods, materials, maintenance equipment, spare parts, instruments, and all surplus/dismantled materials required under the terms of the contract to be handed over to KAHRAMAA other than the permanent works erected on site. The receipt shall state clearly that all items have been received in a satisfactory condition as required by the Contract. The Contractor shall be responsible for demonstrating the satisfactory condition of all items delivered to KAHRAMAA as required, including repacking for storage on site. Such material and items shall be inspected and certified as correct by KAHRAMAA for take over.

7.12 Qatar Municipality Licence

It is necessary under Paragraph 1 of Article 13 of the Decree No.13 of 1968 for Qatar Municipality that contractors obtain a license to work from the Ministry of Municipal Affairs before starting construction works and to obtain a certificate on completion of the work confirming that all reinstatement levelling and removal of surplus earth have been completed to the stated terms of the Municipality by-laws and regulations.

7.13 Breakdown Reports

During the period between the issue of the Certificate of Operational Responsibility and the issue of the Final Certificate the Contractor is to prepare a special report for each interruption of operation or extraordinary case of disturbance indicating in detail how the failure occurred, the reasons for its occurrence and the operational consequences. The Contractor shall further describe the special activities carried out and his preventive measures to allow undisturbed future operation.

In this respect, the Contractor shall also refer to and interpret the operation monitoring records.

Additional investigations shall be carried out by the Contractor if necessary to define the reason for damage or reconcile contradictions.

7.14 Permits, Etc.

All necessary permits from concerned authorities, unless otherwise specified, shall be obtained by the Contractor for the purpose of accomplishing the works covered under this contract, prior to carrying out such works.
No work shall be carried out without a safety document issued by concerned authorities.

7.15 Design Enquiry Letter (for Route Verification)

The cable routes in the drawing attached to the Tender in the Drawings Section are provided for tendering purposes only. Although they are in principle approved by the concerned authorities, the Contractor shall ensure the final approval before commencement of the works as well as the renewals during the course of construction. The correspondence with the concerned authorities will be arranged through KAHRAMAA, while the Contractor shall assist in fulfilling all required information and approvals for proper design, excavation and construction of the proposed works under the Contract through Design Enquiry Letter (DEL) Procedure prior to start to work.

7.16 Application for Road Opening (Permit for Excavation)

Where the final cable route is defined (after excavation of trial pits and Site survey) the Contractor shall arrange the necessary drawings and shall proceed with the Road Openings (RO) procedure as detailed below. No excavation of any kind shall be carried out without RO approvals. Obtaining RO approvals and coordinating excavation work with other utilities, traffic police and municipality shall be the responsibility of the Contractor.

1. Application Form RO1 shall be submitted to Roads Department, ASHGHAL Highway Maintenance Section accompanied by a 1:10,000 location plan and detailed working drawings.
   Similar applications using Form RO1 should be submitted at the same time to all other service authorities whose apparatus could be affected by the works, accompanied by three copies of the drawings to assist processing by the various departments of each authority.
   The accompanying drawings should have at least one set of grid coordinates clearly marked on them to assist in the location of the appropriate record drawings.
2. Roads Department, ASHGHAL Highway Maintenance Section will complete approval Form RO2, after consultation with Road Design Office when necessary, and returned to the originator.
   Similarly, the other service authorities approached should return Form RO2.

   Note:

   a) The approval Form RO2 is only valid for 4 months from the date of reply.

   b) Where work is expected to exceed 4 months duration and provided no changes have been made to the original drawings than 14 days prior to the date of expire, a new RO1 application must be made to all concerned authorities. This re-application need only be accompanied by the location, and the section of Form RO1 regarding the previous application should be completed quoting the reference of the original application.

   c) Works in the vicinity of EHV/HV electricity installations should be strictly in accordance with the Regulations for works in the vicinity of EHV installations, as per attached appendix, particularly the issuance of Service Information Sheet by the Transmission Department.

3. When works are about to commence, Form RO3 shall be submitted to the Traffic Police with a copy of approval Form RO2 from Roads Department, MMA&A, having first been checked for validity by KAHRAMAA.

4. In the case of emergency works, a copy of Form RO4 shall be hand delivered by the site foreman to the Traffic Police.

5. Whenever it is considered necessary the Highway Maintenance Section will implement inspection of the works in progress. In some instances inspection Form RO5 may be implemented to ensure compliance with the Specification.

6. Where works are considered to be substandard or deterioration has occurred during the road maintenance period, the remedial Form RO9 will be issued to the service authority concerned. In general this action will only be taken where a serious hazard exists or informal approaches for improvement have failed.

7. On completion of the maintenance period, the reinstatement shall be inspected and any remedial works undertaken as necessary.

8. QUALIFICATION OF EPC CONTRACTOR

8.1 EPC Contractor's Experience

Contractors shall have had at least ten (10) years previous experience at international level in executing similar or bigger projects and shall have built and placed in successful service not less than three similar installations in the three years prior to the opening date of this Tender. The same applies to manufacturers of major equipment such as GIS, HV Power Cables, Transformers, Protection Equipment, Vacuum Switchgear, Low Voltage Switchgear, Auxiliary Power Supplies, Fire Alarm/Protection Equipment, SCADA/PCS Systems, Microwave Communication Equipment, Fibre Optics, Substation Control Systems, etc..

8.2 Assignment and Subcontracting

In addition to the requirements under Article 16 – Assignment and Subcontracting, it shall be noted that KAHRAMAA's approval of any Subcontractor(s) does not relieve the Contractor of the responsibility and liability arising therefrom as per the Contract. The Contractor shall ensure the presence on Site of equipment manufacturer's specialist technicians and civil work supervisors during the construction, erection, testing and commissioning of major items of equipment and material for Switchgear, HV Cables, Transformers, Protection and Control Equipment, SCADA, Telecommunication Equipment, etc., which they have manufactured.