WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION EM-00-03

GENERAL REQUIREMENTS FOR

SUPPLY OF MECHANICAL, ELECTRICAL AND

INSTRUMENTATION PLANT AND EQUIPMENT

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GENERAL REQUIREMENTS FOR SUPPLY OF MECHANICAL, ELECTRICAL AND INSTRUMENTATION PLANT AND MATERIALS

1. GENERAL

1.1 Extent of Supply

This Specification covers the general design, manufacture, works testing, packing, supply and delivery of mechanical, electrical and instrumentation plant and equipment / Plant and Materials for waterworks applications.

The Contractor / *Contractor* (hereinafter referred to as the Contractor) shall supply all items necessary for a complete working unit irrespective of whether all required components are separately detailed in the Specification.

Particular attention is drawn to the necessity of equipment offered being suitable for the proposed installation and system as a whole, not as individual units, unless supply in loose items is specified.

An itemised list of recommended maintenance tools and spares shall be provided unless otherwise specified. Arrangement and ordering details of the recommended maintenance tools and spares are given in Clause 1.5 below.

Unless agreed by the Engineer / *Project Manager*, the Contractor shall follow the quantity requirement as stipulated in Clause 1.2, 1.3 and 1.6 for equipment submission, drawing and manual. Besides hardcopy, the Contractor shall submit softcopy by any means at the same time for the purpose stipulated in Clause 1.2, 1.3 and 1.6.

1.2 Equipment Approval

Unless otherwise specified, within one (1) month after commencement of Contract, the Contractor shall submit for approval one (1) hardcopy of submission including the make, model and rating of individual plant and equipment / Plant and Materials together with technical details, technical literature and standard drawings of the equipment manufacturer.

Within three (3) weeks from the receipt of the said submission, comment/approval will be given. Within three (3) weeks from approval or conditional approval of the submission, the Contractor shall forward one (1) hardcopy of approved document stamped and certified by the Contractor as true copy, and incorporated with the stipulated amendments as required. If the submission is not approved, the Contractor shall suitably amend the submission without delay and resubmit one (1) hardcopy of the amended submission for approval within three (3) weeks from the receipt of the comments.

The ordering of manufacture of plant or equipment shall not commence before

approval on the same is given.

1.3 Drawing Approval

Unless otherwise specified, within one (1) month after commencement of Contract, the Contractor shall submit for approval one (1) copy of drawings showing the general arrangement, the sectional details, process schematic diagrams and the necessary civil modification works required for the plant and equipment / Plant and Materials. One (1) copies of the drawings for individual equipment shall be submitted within one (1) month of equipment approval as stipulated in Clause 1.2.

Within three (3) weeks from the receipt of the said drawings, comment/approval will be given. Within three (3) weeks from approval or conditional approval of the drawings, the Contractor shall forward one (1) set of approved drawings stamped and certified by the Contractor as true copy, and incorporated with the stipulated amendments as required. If the drawings are not approved, the Contractor shall suitably amend the drawings without delay and resubmit 1 (1) copy of the amended submission for approval within three (3) weeks from the receipt of the comments.

For approved drawings used for the manufacture of the equipment, the drawings shall be resubmitted for approval if any change is required in the manufacturing stage.

The detailed requirements of drawings are stipulated in Water Supplies Department Standard Specification **EM-90-01**.

The Contractor shall note that the approval of drawings will not relieve his responsibility for the soundness of design and suitability of materials on supply of equipment in accordance with the Specification for the intended purpose.

1.4 Inspection, Testing and Reporting

Plant and equipment / Plant and Materials supplied shall be subject to inspection, examination and tests witnessed by an Independent Inspection Body (IIB) at the manufacturer's works as required and in accordance with the Specification. The detailed requirements on inspection, testing and reporting by IIB are stipulated in Water Supplies Department Standard Specification **EM-00-01**.

1.5 Recommended Maintenance Tools and Spare Parts

1.5.1 Spares

The Contractor shall provide a list of recommended maintenance tools and spare parts as required for the operation, testing and servicing of the plant and equipment / Plant and Materials, which may be ordered by the Employer in bulk or individually within the Contract Period. Within one (1) month from the acceptance of equipment submission, the Contractor shall provide any necessary information on spares to enable the Employer to decide on the quantities and which type of spares to be ordered. The information shall include the following:

(a) Detailed breakdown list of spare complete with itemised prices;

(b) Details of manufacturer's model. Reference number, manufacturers' names and contact information; and

(c) Parts and items Drawings.

All spare parts supplied shall be new, compliant with the contract requirement, and strictly interchangeable with the parts for which they are intended to be replaced and shall be treated and packed for long storage under the climatic conditions prevailing at the Site. They shall not be packed with any items of Plant to be erected. All spare parts shall be clearly marked or labelled on the outside of its packing with its description, including part number, and purpose and, when more than one spare is packed in a single case or other container, a general description of container and a detailed list, including part numbers, shall be enclosed. All cases, containers and other packages shall be marked and numbered in an approved manner for purposes of identification. They shall be clearly marked **SPARE PARTS**. Electrical and mechanical spares shall be packed and crated separately.

All cases, containers or other packages are liable to be opened for such examination as the Engineer / *Project Manager* may require and packing shall be designed to facilitate opening and subsequent repacking. Spares shall not be packed on site except under direct instruction from the Engineer / *Project Manager*.

One (1) set of priced spare parts list together with Drawings and/or diagrams giving part numbers, nomenclature and location of individual components shall be supplied for all equipment covered by the Specification. One set shall also form part of the operation and maintenance manuals.

If the equipment components are procured from another manufacturer by the equipment supplier, the Contractor shall provide the name and address of the original component manufacturer and the original part numbers of the spare parts to facilitate re-ordering of spares. Such information shall be included in the operation and maintenance manuals.

1.5.2 Recommended Tools

A complete set of all necessary tools shall be specified by the Contractor to enable any erection, dismantling or testing to be carried out on any part of the Plan whether of an electrical, mechanical or any other nature.

Any tools ordered together with the Contract shall be despatched at the same time as the Plant.

Such tools shall not be used for the erection of the equipment being supplied, and except that the Engineer may call upon the Contractor to demonstrate the effectiveness of any special tool, they must be handed over to the Employer in a new and unused condition. Should the Contractor require any such tools at the Site for erection, he shall provide his own.

Tools for each different type of equipment shall be contained in a suitable box clearly marked or labelled with its description. Each tool shall be identified and a list of tools shall be affixed to the inside of the box lid.

1.6 Instruction Manuals

At least one (1) month before delivery of the equipment, the Contractor shall forward one (1) set of draft manuals for approval. The detailed requirements of instruction manuals are stipulated in Water Supplies Department Standard Specification **EM-90-02**.

Within three (3) weeks from the receipt of the draft manuals, comments/approval will be given. The Contractor shall supply further information within three (3) weeks.

Within one (1) month from the delivery of the equipment, the Contractor shall supply four (4) sets of the final manuals incorporating all necessary amendments, record drawings and works test reports and certificates.

In addition to the manuals in paper form, the Contractor shall also supply a CD-ROM / DVD-ROM / portable hard drive containing PDF files of the final manuals.

2. GENERAL TECHNICAL REQUIREMENTS

2.1 Plant and Materials Design

The design and construction of the plant and equipment / Plant and Materials shall be in accordance with modern technology and the best current industrial practices to achieve energy efficiency and sustainability and shall facilitate ease of inspection, cleaning, lubrication and repair to ensure long life and satisfactory operation under the specified service conditions. It shall comply with Water Supplies Department Standard Specification **EM-00-05** for green procurement if applicable.

Unless otherwise specified, the plant shall generally be designed for round-the-clock continuous operation with maximum safety and efficiency at the duty conditions specified and minimum attendance by the operators. Routine maintenance and repair of the plant and equipment / Plant and Materials shall be kept to a minimum and, as far as possible, not require the services of highly skilled personnel.

The plant and equipment / Plant and Materials shall operate smoothly and without undue vibration. All parts shall be designed to withstand the maximum stresses imposed on them under the most onerous operation and severe test conditions.

The limiting sound pressure level of the plant and equipment / Plant and Materials supplied under the Contract shall not exceed 90 dB(A) measured at any point 1m away from the equipment unless otherwise specified.

Equipment which performs similar functions shall, as far as possible, be of a uniform manufacture, type and model series in order to facilitate maintenance and to minimise stocking of spare parts. Corresponding parts shall be interchangeable. The use of components made in small quantities to meet special requirements such as close-tolerance components shall be stated clearly by the manufacturer and one (1) complete set of spares shall be supplied for such equipment.

Guards, electrical safety devices, thermal insulation, noise suppression devices, safety colour coding and the like shall be provided where needed. The requirements in the appropriate International Standards and statutory regulations shall be followed. Protection guards on machinery shall be rigid and securely fixed, and they shall not have to be removed during normal operation and routine inspection.

Except for consumable items such as gland packing, carbon brushes etc. requiring more frequent replacement, no part subject to wear shall have a life from new to replacement or repair of less than five (5) years of continuous normal operation.

2.2 Materials

Materials incorporated in the equipment shall be new and of first-class quality, free from imperfections and selected for long life and minimum maintenance. The materials shall be of suitable grade and robust construction for the intended purpose. Materials shall be selected to suit the operational environment without corrosion to ensure the designed life of the component parts is met. Materials shall have a high resistance to any change in their properties due to passage of time, exposure to light or any other cause which may have a detrimental effect on the performance or life of the components.

Where dissimilar materials are in contact or within the same proximity which can be bridged by an electrolyte producing a corrosive condition, the electrochemical potential difference between them shall not exceed 250 millivolts. In addition, where there is slight relative motion between two materials in contact, one or both being metals, suitable precaution shall be taken to prevent seizure by fretting.

Stainless steel pieces which are to be welded shall not be subject to intergranular corrosion.

Suitable inhibitors shall be incorporated in brass and bronze where dezincification or dealuminification may occur.

Cadmium plated parts shall not be exposed to weather and high temperature at 50^{o}C or above. Cadmium plated parts shall not be in contact with potable water.

Chromium shall not be electro-plated directly onto ferrous parts. Metallic components (inclusive of legend plates) with chromium plating shall first be nickel plated to a minimum thickness of 0.03mm.

Glass fibre, composite or plastic components shall be of adequate design taking into account the effects of operating temperature, humidity and exposure to sunlight and

they shall be resistant to flame propagation.

The use of organic materials shall be avoided as far as possible but where these have to be used, they shall be treated to make them fire resistant and non-flame propagating.

Asbestos material in any form shall not be used in any part of the plant and equipment / Plant and Materials supplied.

Alternative offers complying with other national or international standards may be accepted provided that the Contractor/supplier/manufacturer can submit supporting information to the Engineer/ Project Manager for acceptance by comparison to demonstrate that such standards are equivalent or superior to the standards as specified in this Specification, in terms of functionality/ performance.

2.3 Standards and Specification

Equipment offered shall comply with the requirements of the Specification, and shall be new, unused and manufactured to the highest commercial standards.

The equipment shall be designed, manufactured and tested in accordance with the latest editions of the relevant International Standards and the standards referred to in the Specification.

Manufacturers offering equipment to other standards shall supply duplicate copies of such standards in English or Chinese (if applicable) and S.I. units together with full details of any deviations from the relevant International Standards indicated.

2.4 Climatic Conditions

All plant and equipment / Plant and Materials shall be suitable for storage, installation and operation in a tropical climate with a maximum relative humidity of 100% and an average ambient temperature of 35^{o}C over any 24 hour period and a maximum ambient temperature of 40 ^{o}C for 4 hours.

2.5 Qualifying Experience

Owing to the requirement for extreme reliability, only equipment of proven design and manufacture will be accepted. The manufacturer shall state his experience in the manufacturing of the equipment and systems on request and provide a list of installed schemes of similar types and sizes as the manufacturer proposes to offer for this application. Unless otherwise specified, the manufacturer shall have at least three (3) years of experience in the manufacture of the equipment or similar items.

2.6 Fluid Handled

2.6.1 Raw Water

When the plant and equipment / Plant and Materials is specified for raw water applications, the water to be handled will be untreated river water relatively free from solid particles. During high flows the water may contain large quantities of silt.

The chemical analysis of samples of the water is shown below:- (Units in mg/l unless otherwise stated)

pH	5.9 – 8.8
Colour (H.U.)	<5 – 80
Turbidity (F.T.U.)	0.4 - 50
Conductivity (µS/cm @ 20 ºC)	25 - 200
Ammoniacal N	<0.01 - 3.62
Albuminoid N	<0.01 - 0.31
Nitrite N	<0.001 - 0.676
Nitrate N	<0.01 - 3.19
Oxygen Absorbed Value	<0.01 - 1.50
Total Dissolved Solids	15 - 130
Alkalinity ($CaCO_3$)	2 - 39
Total Hardness ($CaCO_3$)	4 - 45
Calcium (Ca)	0.4 - 15.2
Magnesium (Mg)	<0.1 - 2.4
Chlorides (Cl)	2 - 50
Sulphates (SO_4)	1 - 20
Ortho - PO_4 (PO_4)	<0.01 - 1.50
Fluorides (F)	<0.01 - 0.35
Iron (Fe)	<0.01 - 1.50
Manganese (Mn)	<0.01 - 2.00
Aluminium (Al)	<0.01 - 0.40
Silica (SiO_2)	0.3 - 18.6
Temperature ºC	13.0 - 31.0
Dissolved Oxygen	0.9 - 9.5

The water shows a faint opalescence with a slight yellow/brown deposit.

In general, the raw water is soft and low in mineral content, occasionally with some microscopic organisms such as zooplankton and phytoplankton. The raw water may be chlorinated to a free residue of 1.0 mg/litre.

2.6.2 Treated Water

When the plant and equipment / Plant and Materials is specified for treated water applications, the water to be handled will be potable, filtered and chlorinated.

The chemical analysis of samples of the water is shown below:- (Units in mg/l unless otherwise stated)

pH	6.4 - 9.2
Colour (H.U.)	<5 - 15
Turbidity (F.T.U.)	<0.1 - 2.5
Conductivity (μS/cm @ 20 °C)	33 - 266
Ammoniacal N	<0.01 - 0.05
Albuminoid N	<0.01 - 0.14
Nitrite N	<0.001 - 0.007
Nitrate N	<0.01 - 3.61
Oxygen Absorbed Value	<0.01 - 0.48
Total Dissolved Solids	26 - 160
Residual Chlorine	0.2 - 3.0
Alkalinity ($CaCO_3$)	4 - 53
Total Hardness ($CaCO_3$)	5 - 111
Calcium (Ca)	2.6 - 33.2
Magnesium (Mg)	0.2 - 10.2
Chlorides (Cl)	3 - 44
Sulphates (SO_4)	4 - 32
Ortho - PO_4 (PO_4)	<0.01 - 0.16
Fluorides (F)	0.05 - 1.11
Iron (Fe)	<0.01 - 0.10
Manganese (Mn)	<0.01 - 0.06
Aluminium (Al)	<0.01 - 0.19
Silica (SiO_2)	3.0 - 17.9
Temperature °C	13.0 - 31.0

2.6.3 Salt Water

When the plant and equipment / Plant and Materials is specified for salt water applications, the salt water abstracted from sea may contain suspended solids and bacteria. The water is normally chlorinated for inhibiting marine growth in the supply system. The water is corrosive calling for the use of high quality materials in the manufacture of equipment.

The chemical analysis of samples of the water before chlorination is shown below:- (Units in mg/l unless otherwise stated)

Specific gravity	1.010 - 1.025
pH	7.4 - 8.9
Turbidity (F.T.U.)	0.3 - 20
Ammoniacal N	<0.01 - 1.0
Oxygen Absorbed Value	0.1 - 10
Chlorides (Cl)	6100 - 20900
Temperature °C	16.0 - 31.0

2.6.4 Recycled Grey Water and Rain Water

When the plant and equipment / Plant and Materials is specified for recycled grey water and rain water applications, the grey water reuse and rainwater harvesting

systems shall be designed in a way that ensures the effluent is fit for purpose and presents no undue risk to health.

Water quality standards for treatment grey water and rainwater effluent is shown below:- (Units in mg/l unless otherwise stated)

E. coli (cfu / 100 ml)	Non detectable
Total residual chlorine	≥ 1 exiting treatment system; ≥ 0.2 at user end
Dissolved oxygen	≥ 2
Total suspended solids (TSS)	≤ 5
Color (Hazen unit)	≤ 20
Turbidity (NTU)	≤ 5
Ph	6 – 9
Threshold odour number (TON)	≤ 100
5-days biochemical oxygen demand BOD_5)	≤ 10
Ammoniacal nitrogen (mg/l as N)	≤ 1
Synthetic detergents	≤ 5

Notes:

1. Apart from total residual chlorine which has been specified, the water quality standards for all parameters shall be applied at the point-of-use of the system.
2. Where recycled water is treated for immediate usage, the level of total residual chlorine may be lower than the one specified in this table.
3. Immediate usage means the collected grey water / rainwater is drawn into the treatment process immediate before a particular round of usage and the treated water will be depleted after that round of usage in complted.

2.7 Nameplates, Rating Plates and Labels

Each item of the equipment shall have a label or labels permanently attached in a conspicuous position detailing its design performance, function, system identification and manufacturer's information.

All labels, nameplates, rating plates and notices shall be permanently marked in English unless otherwise specified. The proposed style, label material, inscription, location and means of fixing shall be submitted for approval before manufacture.

Where withdrawable or detachable equipment is provided, both the fixed and the moving or detachable portions shall be similarly labelled.

2.8 Waterworks Finish

All equipment supplied shall have "Waterworks Finish" as per Clause 2.9 prior to despatch from the manufacturer's works.

Unless otherwise specified, all equipment shall be thoroughly fettled and cleaned and applied with one flat priming coat to all surfaces. Ungalvanised cast iron and steel

parts which are to be painted shall be prepared internally and externally by grit or shot blasting and primed within four (4) hours of blasting. An undercoat shall be applied. Top coats of final colour as specified in Clause 2.9 shall be applied. The colour of the undercoats shall be of slightly different shade to top coats.

All prominent fittings i.e. gland drains, plugs, cocks, etc. and small bore pipework are to be constructed in stainless steel and coating on these items is not required.

Workmanship and the general finish of the equipment shall be of first class quality and in accordance with the best code of practice and shall be performed by persons skilled in their respective trades. All the accessible surfaces, holes and edges of the plant and equipment / Plant and Materials shall be smoothed, deburred and rounded.

2.9 Final Colours for Plant and Equipment /Materials

Plant/Equipment to be Painted	**Coding Colour**	**Colour Reference to BS 4800**
Treated Water Pumps, Valves, Pipes and Fittings	Blue	18E53
Raw Water Pumps, Valves, Pipes and Fittings	Sky Blue	18E51
Salt Water Pumps, Valves, Pipes and Fittings	Green	12D45
Diesel Engines	To match the driven equipment	-
Exhaust Manifolds for Diesel Engines	Silver Aluminium	-
Bulk Fuel Oil Tank	Silver Aluminium	-
Fuel: Service Tanks, Pumps, Pipes and Fittings	Middle Brown	06C39
Lubricating Oil: Tanks, Pumps, Pipes and Fittings	Light Brown	08C37
Sump/Drain/Sludge Pumps, Pipes and Fittings	Black	00E53
Air Compressors	Light Grey/Silver Aluminium	18B21/-
Air Blower and Fans	Light Grey/Silver Aluminium	18B21/-
Air Receivers, Compressed Air and Scour Air Pipes and Fittings	White	00E55
Surge Vessels and Fittings	Silver Aluminium	-
Heat Exchanger	To match the equipment colour	-
Ventilation Ducts and Grilles	To match the wall colour	-
Ventilation Ducts for Equipment	To match the equipment colour	

Plant/Equipment to be Painted	Coding Colour	Colour Reference to BS 4800
Platforms and Ladders except Stainless Steel and Aluminium Alloy	Black	00E53
Handrailings except Stainless Steel and Aluminium Alloy	Sky Blue or To match the surrounding colour	18E51
Overhead Cranes	Yellow	08E51
Crane Hook Block	Red	04E53
Mixture of Air/Hydrogen and Mixture of Air/Flammable Gas Pipes and Fittings	White with Crimson stripes of 50 mm wide	00E55/04D45
Hypochlorite, Sodium Hydroxide and Concentrated Acid/Alkali Solution Pipes and Fittings	Violet with black/yellow stripes of 100 mm wide	22C37/10E53
Chlorine Gas Pipes and Fittings	Yellow	08E51
Gas Insulated Vacuum Circuit Breaker High Voltage Switchboard	Light Grey	-
Low Voltage Switchboard	Light Grey	18B21
Motor	To match the driven equipment	-
Dry Type Power Transformer	Light Grey	18B21
Bulk Oil Power Transformer	Admiralty Grey	-
Battery and Charger Panels	Light Grey (External)	18B21
Capacitor Panels	Light Grey	18B21
Color Label for OSCG pipework: Sodium Hydroxide Hydrochloric Acid Sodium Sulfite / Bisulfite Chlorine Gas Hydrogen Brine Depleted Brine Sodium Hypochlorite Softened Water Cooling Water Waste Water Compressed (instrument) Air Nitrogen	 Orange White Pink Yellow Dark Grey Green Dark Green Violet Light Blue Dark Blue Brown Black Light Grey	-

2.10 Pipe and Fitting in contact with Fresh Water

(1) No material or substance which, either alone or in combination with any other pipe or fitting, material or substance or with the contents of any pipe or fitting of which it forms a part, causes or is likely to cause pollution of fresh water shall be used in the construction, installation, maintenance, alteration, repair of any pipe or fitting which conveys or receives, or may convey or receive fresh water.

(2) The latest Manufacturer's type test reports for the leachability metal testing according to AS/NZS4020:2018 shall be submitted to the Engineer or Project Manager for material approval. The leachability of metals as specified in Table A of all metallic materials and products in contact with fresh water shall not exceed the corresponding limits when tested according to the tests specified with scaling factors for the metallic products under corresponding WSD Standard Specification. Table 2 as quoted in the Appendixes of AS/NSZ 4020:2018 shall be replaced by following Table A. If the limit for any metal is exceeded in the final extract from any sample of the metallic material or product, it shall amount to non-compliance whatever the number of the samples tested.

Table A

Metal	Maximum allowable concentration, mg/L
Antimony (Sb)	0.02
Arsenic (As)	0.01
Barium (Ba)	1.3
Boron (B)	2.4
Cadmium (Cd)	0.003
Chromium (Cr)	0.05
Copper (Cu)	2
Lead (Pb)	0.01
Mercury (Hg)	0.006
Nickel (Ni)	0.07
Selenium (Se)	0.04
Uranium (U)	0.03

Above-paragraph (3) shall not apply to soldering and brazing alloys.

(3) The lead of all metallic materials in contact with fresh water shall not be more than 3.5% by mass.

(4) (a) The lead and antimony of all soldering alloys shall not be more than 0.07% and 0.1% by mass respectively.

(b) The cadmium of all brazing alloys shall not be more than 0.01% by mass.

(5) All non-metallic materials and products in contact with fresh water shall comply with relevant requirements in BS 6920-1:2014, BS 6920-2.1:2014, BS 6920-2.4:2000+A1:2014, BS6920-2.5:2000+A2:2014, BS6920-2.6:2000+A2:2014 or equivalent standards. Table 1 of BS 6920-1:2014 shall be replaced by Table A above.

3. PACKING AND SHIPPING

3.1 General

All equipment and materials supplied shall be adequately protected and packed so as to arrive at site intact and undamaged. The method of protection and packing must be able to withstand any adverse climatic conditions during transit or at site. The packing shall also be able to withstand rough handling and long period of storage at outdoors in tropical climate unless otherwise approved.

Packing shall be suitable for opening up for inspection immediately on receipt and repacked for storage in the same packing without renewal of desiccants.

Unless otherwise specified, all packing cases and other materials necessary for the safe package, conveyance and delivery to the site shall be deemed to have been included in the tender price.

Each package or case shall be clearly marked so that it can be identified with the relevant advice note. It shall be securely attached with a water-proof packing list containing such details as the package number, identification marks and the weight. A duplicate copy of the packing list shall be submitted separately prior to arrival of the equipment.

3.2 Equipment Packing

Equipment ordered for multiple locations shall normally be packed such that each package or case shall contain materials for one location only unless otherwise specified.

Equipment liable to be damaged during delivery or storage, such as instruments and relays, shall be separately packed and individually enclosed in sealed polythene package.

Major electrical equipment such as pump motors, switchgear and control panels shall be packed in wooden containers regardless of whether these are shipped in freight metal containers or not. For tall or bulky equipment that cannot be fitted into a freight metal container, the Contractor shall submit for the approval the full details of the proposed alternative method of equipment package or delivery arrangement.

For shipment, each switchboard and control board shall be packed into transport section not exceeding 2600mm in length in any direction.

Bulk equipment, such as switchgear or control panels, shall be suitably packed for manual handling within the premises with nominal door opening dimensions of 1500 x 2400mm (b x h).

For items above 250kg, lifting eye-bolts shall be provided. For large items where the headroom is inadequate for transport by slings, a suitably designed spreader shall be provided.

For cables weighing more than 3000kg, steel cable drums shall be used. For smaller cable drums, robust wooden drums may be used. In all cases, cable drums shall be designed for outdoor storage for a period not less than 12 months. All exterior surfaces shall be suitably treated for the humid tropical climate. All cable ends shall be capped with heat-shrinkable watertight end-caps.

3.3 Component Packing and Protection

Bearings and parts susceptible to damage by vibration shall be fitted with transit guard or clamps to facilitate attendance to the equipment during temporary storage for operation, e.g. manual rotation by hand to avoid bearing brinnelling etc. A rotor locking device shall be supplied and fitted on each loose motor prior to shipment to prevent any possible damage during transportation.

Parts with grease/oil lubricated elements shall be charged with the correct type and quantity of lubricant for normal operation prior to shipment unless recommended otherwise by the manufacturer. If the manufacturer recommends an alternative method of lubrication or protection for shipment and storage, its details shall be provided for approval.

3.4 Packing Containers

For electrical and instrumentation equipment, the packing containers shall be lined with waterproof paper and provided with a robust water vapour barrier, polyethylene sheeting of minimum thickness 0.5mm, to provide a desiccated package to BS 1133-19 for 6 months in tropical climate.

3.5 Wooden Containers for Packing

Wooden containers shall comply with BS 1133-8. The following additional requirements shall be applicable for cases or containers exceeding 250kg in weight or $2m^3$ in volume:

(a) Crush battens shall be used to prevent side crushing and to render additional support to the lid. One crush batten shall be used at each part likely to be handled by lifting-grabs.
(b) Headers shall be used to distribute the load.

(c) Corner posts shall be used in jointing sheathing elements.
(d) Moisture content of timber used shall not cause moisture condensation when transported in freight containers and shall not exceed 20% in any event.
(e) Skid or sill type base shall be provided.
(f) Bottom sheathing shall be run in the shorter direction.
(g) Blocking method shall be used to prevent movement of load during mechanical and manual handling.
(h) Sharp projections shall be padded with cellulose or equivalent wadding fixed in position with adhesive tape.

3.6 Desiccated Package for Cases Exceeding $2m^3$

The amount of desiccant shall comply with BS 1133-19 with specific requirements as follows:

(a) Desiccant shall undergo positive colour change or an indicator shall be provided for showing excessive moisture content.

(b) Polyethylene bags of minimum 0.5mm thickness or another material of equal robustness and moisture repelling property shall be used.

3.7 Certificates of Compliance and Origin

(a) The Contractor shall, if required, obtain from the manufacturers and submit to the Engineer / *Project Manager*, the Certificate of Compliance proving the Plant and Materials' compliance with the requirements in this contract.

(b) Certificate of Origin of Plant and Materials stating the country, state, name and address of the source, supplier or manufacturer as appropriate, if required, shall be supplied to the Engineer / *Project Manager*, by the Contractor.

(c) Submitted Certificates of Compliance and Origin shall have been authenticated by the authorised representatives of the suppliers or manufacturers. Any inaccurate or misleading information on the certificates may lead to rejection of the Plant and Materials by the Engineer/ *Project Manager*.

4. INTELLECTUAL PROPERTY RIGHTS AND PROPRIETARY RIGHTS

4.1 Intellectual Property Rights

(1) If the Contractor intends to use the intellectual property rights of another party in performing his obligation in a Contract, appropriate licenses should be obtained from the relevant rights owners.

(2) The Employer shall be entitled to reproduce the contents of any technical information which is supplied by the Contractor to the Employer for the purpose of the Contract.

(3) The Contractor shall indemnify the Employer and keep the Employer fully and effectively indemnified against all costs, claims and liabilities if whatsoever nature arising out of or in connection with any claim that the use or possession of the system or any part thereof infringes the intellectual property rights of any third party.

(4) The Contractor shall provide documentary evidence of all licences of all software prior to equipment delivery.

(5) Upon completion of the Contract or after termination, abandonment or breach of Contract, the Contractor shall be deemed to have granted to the Employer and the subsequent owners or occupiers of the system or equipment free of all fees. Under this condition, a non-exclusive licence to utilise the Contractor's Design solely in connection with the execution of the Contract and/or the subsequent alteration, extension and maintenance thereof and for no other purpose whatsoever shall be deemed to have granted without the prior written agreement of the Contractor.

4.2 Proprietary Rights

(1) All proprietary rights in the works, including but not limited to any copyright therein and any rights to apply for patents (hereinafter called "proprietary rights"), shall vest in and become the property of the Employer. However, if any work created outside the Contract ("other work") is utilised in the course of the production or performance of the works, then any proprietary rights in that other work shall remain the property of the Contractor or any third party as the case may be.

(2) The Contractor, if requested, and at the expense of the Employer, shall do all things necessary to enable the Employer to register proprietary rights in the work, as the Employer may reasonably require.

(3) The Employer shall be entitled to reproduce the contents of any technical information which is supplied by the Contractor to the Employer for the purpose of the Contract.

(4) The copyright and other intellectual property rights of whatever nature in the software are and shall remain the property of the Contractor and the Contractor shall have the right to sub-licence the software to any other party or parties.

(5) The Contractor shall indemnify the Employer and keep the Employer fully and effectively indemnified against all costs, claims and liabilities if whatsoever nature arising out of or in connection with any claim that the use or possession of the system or any part thereof infringes the intellectual property rights of any third party.

(6) A complete set of software used in the system shall be supplied. The Employer may make copies of the licensed program as necessary for operational security and used on the system supplied in the Contract. If there are any copyright

constraints by which the end-user cannot copy the software for his own use, this fact shall be clearly spelled out in the Tender.

(7) If the software cannot be used with the equipment because it is inoperative for any reason, then the licence shall be extended without additional charge to use any other replacement equipment.

(8) The Contractor shall provide documentary evidence of all licences of all software prior to equipment delivery.

(9) Upon completion of the Contract or after termination, abandonment or breach of Contract, the Contractor shall be deemed to have granted to the Employer and the subsequent owners or occupiers of the system or equipment free of all fees. Under this condition, a non-exclusive licence to utilise the Contractor's Design solely in connection with the execution of the Contract and/or the subsequent alteration, extension and maintenance thereof and for no other purpose whatsoever shall be deemed to have granted without the prior written agreement of the Contractor.

- End of Specification -