1. GENERAL SPECIFICATION

1.1 Introduction

1.1.1 The Contractor shall be deemed to have thoroughly read the following documents before submitting his tender:-

a) The General Conditions of Tender;
b) The Special Conditions of Tender;
c) The General Conditions of Contract for Electrical and Mechanical Engineering Works;
d) The Special Conditions of Contract;
e) The General Specification;
f) The Particular Specification; and
g) The Drawings.

1.1.2 In the event of conflict between any of the requirements of the above, the order of preference shall be decided by the Engineer.

1.2 Accommodation for Workmen

1.2.1 Workmen are not permitted to dwell on the Site.

1.3 Climatic Conditions

1.3.1 All the equipment and materials provided shall be suitable for operation and standby duties under the following climatic conditions:-

a) Indoor Application

Air Temperature	Maximum 40℃ Minimum 0℃
Relative Humidity	Up to 100%

b) Outdoor Application

Air Temperature	Peak	40℃ Max. ; -5℃ Min.
	Average	0℃ to 35℃

Relative Humidity	99%
Altitude	upto 2,000m above sea level

1.4 Site Access and Storage

1.4.1 The Contractor may be allocated an open area for the storage of equipment and materials and erection of temporary sheds. If allocated, it shall be designated as "Works Area" and its location and other particulars shall be determined on Site.

1.4.2 The Contractor shall provide and maintain all necessary temporary structures, stores, boundary fence and gates, etc. to suit his requirements.

1.4.3 The access route from public roads to the Works Area and the Site may be unpaved. It shall be the Contractor's responsibility to make his own arrangement to ensure that the routes are in a condition suitable for the execution of the Works.

1.4.4 If "Works Area" is not provided, the Contractor shall make all arrangements for the daily supply of the necessary material, etc. for the carrying out of the Works and for the removal of all surplus materials, etc. at the end of each working day.

1.5 Utilities

1.5.1 The Contractor shall make his own arrangements for the supply of water, electricity, telephone connections and other utility services as deemed necessary for the Works Area and for the execution of the Works and shall bear the full cost of these services including deposits, advance payments and disconnection charges, if any.

1.6 Supports and Fixings

1.6.1 Unless otherwise stated, the Contractor shall be responsible for supplying all foundation bolts, shims, clips, fixing channels, cable trays/cleats, conduits etc., required for the satisfactory installation of the Works. Their cost shall be included in the prices against items in the Schedules of Quantities. No bolts are to be shot into the building structure without the prior approval of the Engineer.

1.7 Standards and Statutory Regulations

1.7.1 Where reference is made in the Specification to a British Standard (abbreviated to "BS") it shall be a standard issued by the British Standards Institution and shall be the latest revision of that standard at the closing date for the receipt of tenders.

1.7.2 Where no standards are stated in the Contract, all details, materials, equipment and workmanship shall be in accordance with the relevant British Standards or other acceptable national or international standards.

1.7.3 Where standards other than British Standards are proposed by the tenderer/Contractor, the acceptance will be subject to such standards being equal or superior to the relevant British Standards. The tenderer/Contractor will be required to submit copies of all alternative standards with a list comparing, item by item, the discrepancies between the quoted British Standards and the proposed alternative standards. In the event that the proposed standards are not written in English, the tenderer/Contractor shall also submit their English translation prepared by an authority acceptable to the Engineer.

1.7.4 All mechanical and electrical works shall comply with the technical details stated in the Particular Specification.

1.7.5 Standards for electrical installations shall be in compliance with:-

a) The Electricity (Wiring) Regulations issued by the Hong Kong Government,

b) Codes of Practice for Electricity (Wiring) Regulations, the latest Edition, Electricity Ordinance,

c) "Regulations for Electrical Installations", the latest Edition, issued by the Institution of Electrical Engineers (I.E.E. Regulations),

d) General Specification for Electrical Installation in Government Buildings - B.S.B., E.M.S.D. the latest Edition (the General Electrical Specification), and

e) Local electricity supply company's requirements, and

f) Code of Practice for Energy Efficiency of Building Services Installation,issued by the EMSD, hereinafter referred as the "Building Energy Code" or "BEC".

1.7.6 All site work to be carried out shall comply with:-

a) The Construction Site (Safety) Regulations enforced by the Labour Department, and

b) The Noise Control Ordinance enforced by the Environmental Protection Department.

1.7.7 In addition, the Works and the execution thereof shall comply with all relevant Ordinances, Regulations or Orders having the force of Law in Hong Kong. In this connection, special attention is drawn to the following :

a) Air Pollution Control Ordinance,

b) Dangerous Goods Ordinance,

c) Electricity Ordinance,

d) Fire Services Ordinance.

1.7.8 In the event of conflict between any of the technical requirements of the above, the order of preference shall be decided by the Engineer.

1.8 Drawings and Information to be Provided

The Contractor shall provide the following information at various stages of the Contract. All information given shall be in English. For the case where the information is not given in English, the Contractor shall arrange for the English translation prepared by an authority acceptable to the Engineer and the Contractor shall be responsible for the costs of translation. The Contractor shall not use confidentiality or proprietary information as a reason for withholding the supply of relevant documentation required by the Engineer or the Engineer's representative. Any charges for such material required shall be included in the Contract.

1.8.1 By the Contractor when the Contract is Let

a) Unless otherwise stated in the Particular Specification, the Contractor shall, within 4 weeks from the date of the tender acceptance letter, submit in quadruplicate the following documents and drawings to the Engineer for approval : -

i) Organization chart showing the names and ranks of the staff to be engaged in the project. The organization chart shall also show the telephone numbers or pager numbers, etc of the staff to enable the Engineer or his representative to have efficient contact with any member of staff as mentioned in the organization chart during any stage of the project.

ii) Detailed drawings of the general arrangement, builder's work requirements of the equipment showing the forces to be transmitted to the civil structure, all apertures, holes, trenches, ducts considered necessary by the Contractor for the completion of the Works;

iii) Equipment details giving equipment loadings, dimensions, fixing methods, cable access requirements, schematic and wiring diagrams and cable schedules with estimated route lengths and cable sizes;

iv) Equipment drawings with sectional details of all items of equipment, and

v) Additional drawings of particular items, if required by the Engineer.

vi) Sample board containing samples of all compact-sized materials and accessories to be used on the work. Written acceptance of all samples shall be obtained from the Engineer or his representative before commencement of any installation work for which these materials are required. A label in English bearing the name of the Contractor, the title of the Contract, the name of the manufacturer and the specific service for which the material or accessory is to be used, is to be attached adjacent to each item. The sample board shall be displayed in the Site Office during the entire Contract period. Additionally, the Contractor shall supply sufficient samples of materials as are required in this Specification for testing

purposes. This, where required and stated, shall mean testing to destruction.

vii) Any other information the Engineer or his representative consider necessary to facilitate him understanding the Contractor's submissions.

b) The Contractor may apply to the Engineer for additional copies of any Drawings which the Contractor considers useful in the manufacture of the equipment, provided that the Engineer is satisfied that the request is reasonable. Two copies of the Drawings will be provided without charge. Additional copies if required may be obtained at cost. The Contractor shall treat the copies of Drawings as confidential and shall not use them other than for the purpose for which they are provided.

c) The manufacture of equipment shall not commence until the approval of all relevant drawings, parts lists and materials have been obtained in writing. All costs resulting from failure to comply with this requirement shall be borne by the Contractor.

d) Original (and in quadruplicate) official type test certificates for major components and all plant equipment shall be submitted to the Engineer at least 4 weeks before the components/equipment depart from the manufacturer's factory and prior to shipment.

e) The Contractor shall, before starting work on his drawings for approval, ascertain from the Engineer whether any modifications on the Drawings have been made since the date of the acceptance of his tender.

f) If the drawings are not approved, one set will be returned to the Contractor marked to indicate the alterations required. Upon approval, one copy will be marked "Approved" and returned to the Contractor. Approval of the Contractor's drawings given by the Engineer shall not absolve the Contractor from his contractual responsibility to fulfil the requirements of the Contract.

g) Within 2 weeks after approval of the drawings, a further four sets shall be provided for the use of the Engineer.

h) All drawings shall be specific to the Works and shall be titled in the bottom right hand corner with the Contract title and Contract number.

1.8.2 By the Contractor Prior to the Issue of the Certificate of Completion

a) At least two months before the commissioning of the installation, the Contractor shall submit two copies of draft "Operation and Maintenance" Instruction Manual to the Engineer for approval.

b) After the draft Instruction Manual is approved, the Contractor shall supply five copies of the approved version of the manual which shall be properly bound in book form with hard and durable covers and properly indexed to facilitate easy reference. The manual shall include the following:-

i) General arrangement drawings of equipment including complete wiring, cabling and control diagrams;

ii) Drawings showing the internal construction of major items, with part lists and reference numbers for spares identification and ordering purposes;

iii) Detailed specification and operating instructions for each item of equipment, including drawings indicating the positions of all the greasing and oiling points;

iv) A list of recommended lubricants and other consumable materials, if any;

v) A list giving the names and addresses of manufacturers and their local agents for each item of equipment;

vi) A preventive maintenance programme and procedures for all individual items of equipment;

vii) Procedures to facilitate diagnosis of faults and emergency breakdown;

1.8.4 By the Contractor 1 month prior to the Issue of Defects Liability Certificate

a) The Contractor shall furnish one permanent, reproducible transparency and three prints in A1 size of each drawing of the Works complete with parts list and materials list approved during the course of the Contract including any modification found necessary during the Defects Liability Period.

b) The Contractor shall softcopy of as-fitted drawings in both Acrobat and AutoCAD format.

1.8.5 Importance of Information Submission as regards to Completion of Works

a) The Contractor shall note particularly that the Defects Liability Certificate will not be issued unless the information specified in sub-paragraphs 1.8.1, 1.8.2, 1.8.3 and 1.8.4 has been received and accepted by the Engineer and the Contractor shall also be fully responsible for any possible consequence which may arise from his late submission of the said technical information.

1.9 Training Programme on the Operation and Maintenance of Equipment for Local Staff

1.9.1 Unless otherwise stated in the Particular Specification, the Contractor shall arrange a training programme for the local operational staff of various grades to familiarize with the detailed operation and maintenance procedure of the equipment. The Contractor shall prepare and submit the training programme for approval 2 months after the acceptance of tender. The training programme shall be comprehensive and of sufficient details to enable the operational staff to handle confidently, safely, and efficiently the operation and maintenance of the complete installation.

1.10 Contractor's Programme of Work

1.10.1 In accordance with Clause 16 in the General Conditions of Contract, the Contractor shall, within 14 days after the acceptance of the tender, submit a provisional programme of his work to the Engineer for approval.

1.10.2 The dates of manufacture of each and every item of equipment, shipping,

delivery to the Site, installation, testing and commissioning of the completed assembly shall be clearly shown on the programme in bar chart form.

1.10.3 Once the programme has been approved by the Engineer the Contractor shall not deviate from the programme without approval from the Engineer.

1.11 Work Progress Reports and Meetings

1.11.1 The Contractor is required to submit a bimonthly report prior to the site installation date and a monthly progress report thereafter to show the progress of construction, scheduling for any anticipated delivery delay or other relevant information against each activity and confirming that the agreed date of completion will be met. Should there be any delay, a detailed explanation shall be given in writing.

1.11.2 From time to time the Engineer may call project progress meetings in his office or at the Site, as he deems necessary for the control of the Contract. Normally these meetings will be held at intervals of one month. The Contractor shall arrange his approved site representative or other responsible person to attend such meetings.

1.12 Delivery of Equipment and Materials

1.12.1 No Constructional Plant, equipment or materials shall be delivered to the Site until approval in writing has been obtained from the Engineer.

1.12.2 The Contractor shall be responsible for reception on the Site of all Constructional Plant, equipment and materials delivered for the purposes of the execution of the Contract, its transfer to the proper storage space, its safety and its transfer to the place of installation at the appropriate time.

1.13 General Requirements, Workmanship and Design of Equipment

1.13.1 All equipment and materials shall be brand new, of sound workmanship and robust field-proven design, and as far as practicable from standard production.

1.13.2 The general mechanical and electrical design of the equipment and particularly that of the bearings, contacts, and other wearing parts shall be governed by the need for long periods of service without frequent maintenance and

attention being necessary. For the purpose of this Clause, "long periods" shall mean a period of not less than 3 years.

1.13.3 Unless otherwise specified, all items shall be designed for at least 15 years' operating life and shall be suitable for 24 hours per day continuous service with capability to be operated intermittently at the specified duties under the prevailing atmospheric and operational conditions on the Site.

1.13.4 The design shall also include all considerations such as safety requirements, minimum maintenance commitment, ease of operation and maintenance access etc. in order to obtain an overall efficient installation.

1.13.5 All components shall be manufactured to a strict system of limits and complete interchangeability of similar parts is required.

1.13.6 All items for which spare parts may be required shall have attached to them untarnishable metal plates clearly showing the manufacturer's name, serial numbers and basic information as to rating, etc., in sufficient details to allow the unit or assembly to be identified in correspondence when spare parts are to be ordered.

1.13.7 All parts subject to wear shall be readily accessible.

1.13.8 Adequate and, as far as practicable, automatic means of lubrication shall be provided for all moving parts.

1.13.9 The positions of all greasing and oiling points shall be arranged so that they are readily accessible for routine servicing. Where necessary suitable extension pipes shall be fitted.

1.13.10 Lubrication grease points shall be fitted with metal labels in both English and Chinese to indicate the special lubricant required.

1.13.11 Where continual grease or oil feeding is required, the capacity of the reservoir shall be sufficient for not less than seven days' continuous service. Indications of the reservoir content in the form of gauges, meters or visual alarms shall be provided.

1.13.12 All pipes and shafting shall be checked for alignment and mating of flanges or

connections before being secured.

1.13.13 If during the Defects Liability Period any moving parts show in the opinion of the Engineer signs of undue wear or unsuitability for the purpose for which they are installed then they shall be replaced free of charge notwithstanding that they may otherwise be working in a satisfactory manner.

1.13.14 All metal works associated with the electrical installation shall be bonded together and shall be solidly and effectively earthed.

1.13.15 The available electricity supply is 380/220 volts, three phase 50 Hz. The equipment offered shall be capable of operating at 380/220.

1.13.16 In accordance with the Electricity Ordinance, the Contractor shall employ a Registered Electrical Contractor/Worker to carry out all electrical installations within the scope of this Contract. After the electrical installation of the Contract is completed, it shall be inspected, tested and certified by a Registered Electrical Worker to confirm that the requirements of the Wiring Regulations have been met. The Registered Electrical Worker and Contactor shall sign the Work Completion Certificate for their individual electrical installation and submit it to the Engineer before the electrical installation is energised.

1.13.17 Adequate sized multi-core PVC SWA PVC cables shall be supplied and installed in outdoor underground G.I. pipes and PVC cables of adequate size shall be used indoor and shall be run in concealed conduits.

1.13.18 Junction boxes shall be supplied and installed for connecting outdoor armoured cables with indoor PVC cables. Cable entries into a building shall be resealed by approved means to prevent the ingress of moisture and vermin. Armoured cables shall be terminated in a gland fitted with an armour clamp. A watertight seal shall be made between the gland and the inner PVC cable sheath. A PVC shroud shall be fitted to cover the body of the gland and the armoured wires.

1.13.19 Motors shall comply with British Standards BS 4999-141:2004+A1:2010 General requirements for rotating electrical machines. Specification for standard dimensions and shall be of such size and type to adequately drive the equipment under all normal conditions of service without overloading. Insulation shall be of minimum Class F for tropicalised conditions.

1.13.20 Each starter for the motor shall comply with IEC 60947-4-1:2012 -. Electromechanical Contactors and Motor-Starters and shall be provided with an adjustable motor overload protection device and undervoltage release suitable for the motor load and having manual resetting facilities. Direct-on-line starters shall be used for motors smaller than 3.8kW and for motors over 3.8kW, star-delta starters shall be used instead.

1.13.21 All secondary wiring shall be complete with numbered ferrules for identification which shall be carried out in a neat and systematic manner and finished at a terminal board at the junction of small wiring and the incoming cables.

1.14 Surface Preparation

1.14.1 All steel works shall be protected against corrosion. The protective treatment shall accord with the recommendation of ISO 12944:1998+Part 5:2007– Paints and Varnishes: Corrosion Protection of Steel Structures by Protective Paint Systems unless otherwise specified.

1.14.2 All steel surfaces shall be thoroughly cleaned of all dust, oil, grease, scale, rust or other contaminants.

a) Degreasing

i) Grease and dirt should be removed by emulsion cleaners followed by thorough rinsing with water, or by steam-cleaning or by controlled high pressure water jets, wherever practicable.

ii) When it is necessary to use turpentine or similar solvents to remove oil and grease, the use of detergent or emulsion cleaner shall follow and then by thorough rinsing with clean fresh water. Degreasing by washing in solvent shall not be used.

b) Removal of Scale and Rust

i) Unless specially specified in the Drawings / Particular Specification, rust and mill-scale must be removed before painting by manual cleaning.

ii) Manual cleaning shall be carried out by a power tool with rotary wire brush and then followed by vacuum cleaning to remove all loosened material.

iii) Excess burnishing of the metal through prolonged application of rotary wire brushes shall be avoided. Visible peaks and ridges produced by the use of mechanical cleaning tool shall be removed.

iv) If blast cleaning is required, it shall be carried out in accordance with ISO 8504:2001 – Surface Preparation Methods. The quality of blast-cleaning shall be to the preparation grade Sa 2.5 as given in ISO 8501-1:2007 and ISO 8501-2:1994 unless otherwise specified. The Contractor should select the most appropriate method of blast-cleaning according to the shape and size of the steel work and the type of surface deposit to be removed.

v) The maximum grade of metallic abrasive permitted shall be as specified in ISO 8501-1:2007 and ISO 8501-2:1994. The abrasive used for blasting shall be free from harmful contamination and any recovered material shall be filtered and cleaned before reuse.

vi) The blast-cleaned surface shall have a small profile size. Blast-cleaned surfaces shall be dusted by brush or vacuum and shall not be touched by hand or other contaminated materials.

1.15 Coating System

1.15.1 All steel surfaces supplied under this Contract shall be coated with 2 layers of Rust Oleum #769 Damp-Proof Red Primer, or equivalent, and then with a finish layer of Industrial Enamel paint of approved colour.

1.15.2 For high temperature application up to 400^{o}C, the material surface shall be applied with 2 layer of Rust Oleum #4268 rust inhibitive heat resistant red primer, or equivalent, and then a finish layer of Rust Oleum #4200 system, or equivalent, heat-resistant finish of approved colour. For application higher than 400^{o}C, the types of paint used shall be submitted for approval before use.

1.15.3 Methods of Application

a) Priming

The application of primer to prepared steel surfaces shall be by hand brushing. Painting should only be carried out on dry surfaces when the relative humidity is less than 80% with an ambient temperature above 5℃ and material surface temperature at least 3°C above dew point, or in accordance with paint manufacturer's recommendation. Each layer shall be applied within 4 hours after the previous layer is completely dry.

b) Finishing

The finishing coat shall be applied by spraying or other approved method. It shall be carried out in a dry, draught-free atmosphere to avoid the work becoming spoiled by condensed moisture, dust etc. The finish shall be reasonably smooth.

1.16 Standards of Welding and Structural Steel

1.16.1 All welding shall be carried out only by welders of recognized proficiency, and to the satisfaction of the Engineer. The welding electrodes, equipment and process shall be in accordance with the following British Standards : -

a) BS 2633: 1987 Specification for Class I Arc Welding of Ferritic Steel Pipework for Carrying Fluids

b) BS 2971: 1991 Specification for Class II Arc Welding of Carbon Steel Pipework for Carrying Fluids

c) ISO 2560:2009 Welding Consumables - Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steels – Classification

d) BS EN 1011-1:2009 Welding – Recommendations for Welding of Metallic Materials. General guidance for arc welding

e) IEC 60974-6:2015 Arc Welding Equipment- Limited Duty equipment

f) BS EN 50525:2011 Electric cables – Low voltage energy cables of rated

voltage up to and including 450/750 V (U0/U).

1.16.2 Welding shall not be carried out under unfavourable conditions. The Contractor shall make certain that all welded surfaces are clean and dry before any welding is to be done.

1.16.3 Steel plates and structural steel sections for general purposes shall conform with the requirements of the following British Standards:

a) BS 7668:2004 Weldable Structural Steel - Hot Finished Structural Hollow Sections in Weather Resistant Steels – Specification

b) BS EN 10029:2010 Hot-rolled steel plates 3 mm thick or above – Tolerances on dimensions and shape

c) BS EN 10025:2004 Hot Rolled Products of Structural Steels

d) BS EN 10210:2006 Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Steels

e) ISO 14713:2009 Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures

All forms of steel used shall be of standard section with dimensions, tolerances and properties complying with BS 4-1:2005, BS EN 10210-2:2006, BS EN 10056-1:1999 and BS EN 10067:1997.

All exposed edges shall be ground to produce a chamfer of not less than 2 mm in width.

1.17 Spares and Packing

1.17.1 Spares shall be readily interchangeable with the parts they replace, and shall comply with the Specification. The Contractor shall be deemed to have included in the Contract the minimum spares if specified. In addition the Contractor shall submit an itemized price list of further spares which he considers necessary for 2 years' operation of the equipment. The Engineer will

determine the spares to be supplied under the Contract and payment will be assessed according to the itemized prices.

1.17.2 Spares shall be packed and protected for storage to "BS 1133-8:2011+A1:2016 Packaging code- Guidance on wooden boxes, cases and crates". Electrical equipment shall be sealed in polythene or similar bags with a liberal supply of desiccant. Other items shall be protected so as to avoid corrosion for a minimum of twenty-four months after delivery. Each package shall have attached to it an untarnishable metal plate giving information for identification. This shall include the maker's name and reference descriptions which must correspond fully to those given in the relevant drawings and parts book. Each spare part shall be permanently marked with its part number.

1.17.3 The packages of spares shall be delivered by the Contractor into consignments of reasonable size and then packed in secure cases each of which shall contain a contents list.

1.17.4 Where electrical items are involved, the cases shall be of tongue-and-groove boarding, or of durable plastic containers. Each case shall be durably marked with the contract number and site address, and shall be sent to the Site or to a Government store after detailed instructions for despatch have been received from the Engineer.

1.18 Tools

1.18.1 The Contractor shall recommend in the relevant schedule a complete set of special tools necessary for the erection, dismantling or testing to be carried out on any part of the installation.

1.18.2 The tools recommended may be ordered in part or not ordered at all. Payment will be assessed according to the itemized prices quoted in the relevant schedule.

1.18.3 The tools to be recommended shall include special wrenches, grease guns, bearing extractors, impeller pullers and any special slings and lifting appliances which may be required during the life of the equipment.

1.18.4 All tools shall be supplied in lockable wall or floor mounted cabinets. The tool cabinets shall be clearly marked to indicate the equipment they are to be used

for. All locks shall have a common key. Each tool cabinet shall be provided with two keys.

1.18.5 The tools shall not be used for the erection of the Works and must be handed over to the Engineer in a completely new and unused condition.

1.19 Delivery of Spares and Tools

1.19.1 Spares and tools delivered to the Site shall be received by the Engineer. They shall not be delivered to the Site until instructions for their reception have been obtained from the Engineer.

1.20 Protection of Equipment

1.20.1 All equipment and machinery shall be carefully packed for transport in such a manner that it is protected against all climatic conditions.

1.20.2 The machined face of all flanges shall be protected by means of a hardwood blank disc bolted to the face.

1.20.3 Special precaution shall be taken to protect all journals where they rest on wooden or other supports likely to contain moisture. At such points, wrappings impregnated with rust-resisting materials shall be used. The wrapping shall have sufficient strength to resist chafing through.

1.20.4 Adequate precautions shall be taken in packing machinery which incorporates ball and/or roller bearings, so as to minimize the risk of damage to the bearings in transit.

1.20.5 All crates shall be marked with standard international symbols relating to lifting points and other relevant markings.

1.20.6 The ends of tubes and similar components shall be protected from the ingress of dirt during transit and storage. This may be done by means of metal or rubber caps or wooden plugs etc., and this protection shall not be removed until the erection of the tube or similar component actually commences.

1.20.7 For other means of protection not mentioned above but considered necessary for the protection of the Works, the Contractor shall submit his proposals for

the approval of the Engineer.

1.20.8 All equipment delivered to Site shall be properly protected so that it does not deteriorate in any manner. The Engineer may order the Contractor to adopt such methods of storage and protection as the Engineer thinks necessary to avoid such deterioration. The adoption of such methods shall be at no extra cost to the Employer.

1.20.9 Any damage occurring to any item brought to the Site or stored on the Site shall immediately be brought to the attention of the Engineer. The Contractor shall submit to Engineer his proposals for remedial works to the damage, and no remedial work shall be done without approval on those proposals. The Engineer reserves the right to reject entirely any damaged items which in his opinion are not restorable to a satisfactory condition for use in the Works.

1.20.10 The Contractor shall make good at his own expenses to the satisfaction of the Engineer any deterioration of the protective coatings, paintwork, etc., which may occur during transportation, erection, commissioning, etc., until the Works are taken over.

1.20.11 Items of equipment which are finish painted at the manufacturer's place of work shall be suitably encased in wood for their protection before despatch. Any deterioration of, or damage to paintwork etc., which may occur during the intervening period until the equipment is taken over shall be made good at the Contractor's expense.

1.20.12 Electrical items shall be properly protected from ingress of water/moisture.

1.20.13 Within one week after delivery of all items of equipment to the Site, the Contractor shall provide four copies of the complete schedule listing all items of equipment in sufficient details to enable them to be readily identified.

1.21 Testing, Inspection and Commissioning

1.21.1 In addition to the requirements in Clause 42 of the General Conditions of Contract, the following paragraphs 1.22, 1.23, 1.24 and 1.25 shall also be applicable to the testing, inspection and commissioning of the installations provided under this Contract.

1.22 Testing and Inspection before Installation on Site

1.22.1 The Contractor shall offer all materials and components of the installation for inspection, examination and witnessed testing to ascertain satisfactory functioning of the equipment before assembly and installation on Site and shall inform the Engineer of the firm dates for inspection and witnessed testing giving four weeks' notice.

1.22.2 General tests as described in a) to j) below shall be adopted by the Engineer for the examination of all materials and components, sub-assemblies and unit assemblies. Details of these tests shall be in accordance with the specification for that particular item described elsewhere in the Specification.

a) Physical inspection;
b) Dimensional check;
c) Electrical check;
d) Calibration;
e) Output check;
f) Operational test;
g) Reliability test;
h) Load testing;
i) Insulation test and
j) Others as deemed necessary.

1.22.3 If the tests are beyond the resources of the manufacturer, the Contractor shall make arrangements for these to be carried out elsewhere. Any variation of this requirement shall be agreed and confirmation in writing obtained from the Engineer.

1.22.4 The Contractor shall supply four unpriced copies of all sub-orders and those items not manufactured at his place of work. Two copies each of these sub-orders shall be forwarded to the Engineer and two to the Engineer's Representative. The sub-orders shall indicate the details of work for which the items are required, state in detail the inspection and test requirements, giving sufficient information for ready identification and shall state that these items will be subject to witness test and inspection.

1.22.5 The Contractor shall carry out tests as stated in the current appropriate British

Standards, performance tests and such other tests as are necessary, in the opinion of the Engineer, in order to verify that the workmanship, equipment or materials are in compliance with the Specification either under test conditions in the manufacturer's place of work, or on the Site.

1.22.6 Where hydraulic power packs or pumping systems are included in the Contract, all units shall be tested with the suction and discharge rigged to conform to the Site conditions.

1.22.7 Prototype or special tests shall be carried out for some critical items of equipment to ensure correctness of assembly and ease of re-assembly at the Site. The assembly shall be adequately marked and dowelled. The details of the above tests for the critical items are stated elsewhere in the Specification. The Contractor shall satisfy the Engineer that the assembled items meet the performance requirements, and are fully compatible not only in respect to the equipment supplied under the individual technical specification but also in respect to other equipment forming the system.

1.22.8 All cast metal components designed for the retention of liquid, e.g. pump casings, gear boxes, engine crank cases, etc., shall be checked for soundness after machining, but before assembly.

1.22.9 All cast of fabricated metal components which will be subjected to high stresses during operation, e.g. pump impellers, shall if considered necessary by the Engineer, be subjected to non-destructive testing in accordance with BS EN 1369:2012 Founding. Magnetic particle testing. BS EN 1371-1:2011 Founding. Liquid penetrant testing. Sand, gravity die and low pressure die castings. BS EN 12680-1:2003 Founding. Ultrasonic examination. Steel castings for general purposes and BS EN 10228-3:2016 Non-destructive testing of steel forgings. Ultrasonic testing of ferritic or martensitic steel forgings. BS EN 10228-4:2016 Non-destructive testing of steel forgings. Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings.

1.22.10 Where tests and inspection have been completed to the Engineer's satisfaction, and when the test certificates, curves, etc., have been checked, he will confirm acceptance in writing. The equipment shall not be delivered to the Site until this acceptance has been received.

1.22.11 Two copies of all test certificates and curves shall be supplied to the Engineer

within two weeks of completion of any witness tests.

1.22.12 Where witnessed tests are not required the test certificates and curves shall be forwarded to the Engineers within two weeks after instruction to waive witnessed tests have been received.

1.22.13 On each test certificate, sufficient information including the specification, contract number and equipment details, shall be given for the ready identification of the material or equipment to which the certificate refers. The format of the test certificate shall be subject to approval.

1.22.14 No inspection or approval by the Engineer of the workmanship, equipment or materials covered by this Contract, whether carried out or supplied by the Contractor, shall release him from any of his obligations under the Contract.

1.22.15 The Engineer reserves the right to require the Contractor to meet any extra costs which are occasioned by failure of the Contractor to comply with the above testing and inspecting requirements, including the provision of test certificates, curves, etc., or which in the opinion of the Engineer are due to insufficient care having been taken by the Contractor or his Sub-contractor before presenting the equipment for inspection or test. If unauthorized delivery has taken place, the Contractor may be required to arrange for additional inspection and/or witness testing by the Engineer at the Contractor' expenses.

1.22.16 All apparatus, instrument and connections required for the tests shall have been calibrated by approved authorities for accuracy within the preceding 12 months. The Contractor shall be responsible for the costs of all such calibrations and present calibration certificates to the Engineer for approval.

1.22.17 Any equipment used in the testing of the Works shall in all respects comply with the appropriate safety regulations.

1.22.18 For testing/inspection at a sub-contractor's place of work, the Contractor's Representative shall accompany the Engineer or his Representative on each visit.

1.23 Site Testing of Sub-assemblies

1.23.1 On completion of installation, each sub-assembly of motor unit, switchgear, power pack, pipelines and other equipment shall be individually tested to

ensure proper functioning. The tests shall be able to demonstrate their achievement of the designed performance and satisfactory operation when all the sub-assemblies are running together. All defects of the sub-assemblies shall be properly rectified to the satisfaction of the Engineer.

1.23.2 Unless otherwise stated in the Particular Specification, all electrical tests shall be in accordance with the requirements stated in the standards mentioned in Clause 1.7.5 above.

1.23.3 For sectional pressure tests on pipelines, immediately after the satisfactory completion of the tests, the Contractor shall flush out, remove all foreign matters and clean all the systems. Whenever possible the flushing medium shall be fed into the system at high points and flushed out at low points on the system via suitably-sized valve or plugged wash out points.

1.24 Commissioning Tests

1.24.1 As soon as practical after individual equipment, sub-assemblies and assemblies have been properly installed, tested to the satisfaction of the Engineer, the Contractor shall carry out the commissioning tests for the complete installation.

1.24.2 Eight weeks prior to the commencement of testing and commissioning, draft as-fitted drawings and 'Operation and Maintenance Manuals', in English and/or Chinese, shall be submitted for the Engineer's approval prior to producing formal copies of as-fitted drawings and O&M manuals.

1.24.3 The Contractor shall notify the Engineer three weeks in advance of the commencement of commissioning tests, and furnish a detailed programme and description of methods of carrying out such commissioning tests for approval. Unless otherwise agreed the tests shall take place within ten days after the said date, on such date or dates as the Engineer shall in writing notify the Contractor.

1.24.4 The installation shall then be operated continuously by the Contractor for 24 hours or such time as the Engineer may specify, during which time the Engineer will check that the installation is complete, in safe working order and fulfils the functions for which it is intended.

1.24.5 Any defects of workmanship, materials, performance, design of equipment,

maladjustments or other irregularities which become apparent during the tests shall be rectified by the Contractor and the tests repeated at the Contractor's expense to the satisfaction of the Engineer.

1.24.6 If any portion of the Works fails to pass the tests, tests of the said portion shall, if required by the Engineer or by the Contractor, be repeated within a reasonable time under the same terms and conditions, save that all reasonable expenses to which the Employer may be put by the repetition of tests shall be deducted from payments due to the Contractor.

1.25 Costs for the Testing, Inspection and Commissioning

1.25.1 The Contractor shall be responsible for all the costs associated with testing, inspection and commissioning of the Works. These include the costs for the provision of assistance, instrument, machines, labour, consumable materials such as water, fuels and chemicals, etc and other facilities as may be necessary.

1.26 Labels

1.26.1 Each item of plant shall have permanently attached to it in a conspicuous position a label upon which shall be engraved or stamped the manufacturer's name, type and serial number of the plant and details of the loading and duty at which the items of plant have been designed to operate. Such labels shall be of non-hygroscopic material.

1.26.2 Labels shall be provided for every control panel and local cubicle to describe the duty as well as to describe/identify every instrument, relay or item of control equipment mounted externally or internally.

1.26.3 Labels shall be of laminated plastic, with letters and numbers engraved in contrasting colour to the background. Embossed materials and the like will not be accepted.

1.26.4 All indicators, instruments, relays, control switches, push-buttons, fuses and other ancillary apparatus shall be provided with labels clearly stating their functions. All label inscriptions shall be to the approval of the Engineer.

1.26.5 All labels shall be fixed square to the equipment by means of screws or rivets. Labels affixed with adhesive will not be accepted.

1.26.6 Labels indicating normal operational procedures, circuit designations and warning labels, shall be inscribed in English and Chinese characters.

1.27 Initial Charges of Consumable

1.27.1 The initial charges of consumable such as oil, grease, fuels, lubricants, electrolytes and similar materials necessary for the correct setting to work and operation of the Works shall be included in the Contract Sum.

1.28 Prevention of Mosquito Breeding

1.28.1 All items on the Site, including Constructional Plant, and equipment capable of retaining water shall be so stored, covered or treated as to prevent water collecting and the Contractor shall allow for the cost of so doing.

1.28.2 The Contractor shall, at his own expense, obtain and display prominently, upon all structures or temporary offices on the Site, posters, in both English and Chinese, drawing attention to the dangers of allowing the breeding of mosquitoes. These posters, which may be obtained from Food and Environmental Hygiene Department, shall be removed on completion of the Works.

1.29 Advertising on the Site

1.29.1 No advertising notice boards of any kind are to be erected on the Site without the prior consent of the Engineer in writing. The proposed advertising board design shall be submitted to the Engineer for approval well in advance of the intended erection.