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JAPAN INTERNATIONAL COOPERATION AGENCY

THE GOVERNMENT OF
THE HASHEMITE KINGDOM OF JORDAN
THE MINISTRY OF TOURISM AND ANTIQUITIES
THE MINISTRY OF PLANNING

DRAFT

TENDER DOCUMENTS
FOR
CONSTRUCTION

OF

KARAK TOURISM DEVELOPMENT SUB-PROJECT

THE TOURISM SECTOR DEVELOPMENT PROJECT

VOLUME II

SPECIFICATIONS

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TABLE OF CONTENTS

6SP-AS

TABLE OF CONTENTS

TABLE OF CONTENTS

6SP-ME

DIVISION 15 - MECHANICAL

TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

DIVISION 15

MECHANICAL

BUILDING WORK

DIVISION 15

MECHANICAL

INDEX

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the basic general requirements applicable to all Division 15 works, that shall be provided for by the Contractor.

1.02 CALCULATIONS

A. The Contractor shall acquaint himself with the constructional details of the buildings and exterior works both before and during the course of erection and shall take his own particulars with regard to the installation of mechanical equipment. The Contractor shall check the sizes of all mechanical equipment taking into account any additions or deletions required to ensure the installations fit into the room or other spaces allocated and in relation to other plant and equipment being provided.

B. The Contractor shall undertake and prepare all necessary calculations and drawings relating to the mechanical equipment and for all associated foundation, structural and builder's and services work, except where specifically defined otherwise in the Specification and/or on the Drawing.

C. The Contractor shall provide and submit to the Engineer all calculations, drawings and supporting data for the mechanical equipment.

D. The Contractor shall provide calculations, details, drawings and technical data to enable the Engineer to ascertain the correctness of the specialist designs of the associated foundations, supports, bases and fixings.

1.03 WORKING DRAWINGS

A. The Contractor shall provide for approval working drawings of the whole mechanical works. The drawings shall include, but not necessarily be limited to the followings:-

1. Co-ordinated general arrangements of all services to a scale of not less than 1:100

2. Co-ordinated detailed layouts of plant rooms and similar spaces to a scale of not less than 1:50.

3. Schedules of all equipments to be installed, together with start and running power consumption.

4. Indicate with accurate dimensions sizes and positions of all plant, equipment, pipes, conduits,trunking, underfloor ducting, cable tray, cables together with all inspection points and cable joints.

5. Fully indicate all ductwork, pipework, sizes and positions of all plant equipments and valves together with all inspection points and test positions.

6. Fully indicate all builder's work requirements inclusive of all foundations, bases, plinths, sumps and holes together with the overall sizes and masses of the plant concerned.

7. Show the disposition and depth of all cables, pipes, ducts, buried direct in the ground and taken at intervals where change of direction occur and where cables increase or decrease in number/size and at every point where the services enter into or depart form ducts or buildings.

8. Indicate the number, size and services for every cable, ducts, pipes for every service within the building. Circuit lists for every distribution board shall be entered onto the relevant drawings and such lists shall agree with the lists fixed within the distribution board door.

9. Indicate all equipment and control wiring diagrams together with all specialist systems.

10. Show all cables in pits and ducts on drawings to a scale of 1:50 or larger.

11. Show clearly on site drawing all the new buildings together with all other existing buildings and other permanent features and dimensions between such buildings and cables, pipes, ducts, etc. clearly marked.

12. Show clearly all plumbing and drainage and setting out dimensions for all drainage pipework and manholes, both within the building and throughout.

13. The site, together with intended drainage pipework backfill, or surround in each location, schedule to be included to indicate manhole, and cover size, etc.

B. The symbols used for each service for all working drawings shall be shown on separate drawings.

C. In addition to the working drawings, the Contractor shall obtain and provide at the request of the Engineer, two sets of all manufacturer's detailed drawings for all items of plant, equipment, apparatus and materials. These drawings shall be suitably titled and have drawings references number added. Specific requirements are given in the individual specification Sections.

D. All drawings, diagrams and schedules called for in this clause shall be submitted to the Engineer for examination and approval.

E. The Contractor shall make due allowance for an approval/comment period and it must be clearly understood that the correctness of the submitted information will directly affect this comment/approval period.

F. The Contractor shall be responsible for co-ordinating all mechanical, electrical, fire protection plumbing, drainage condensate, and irrigation works, and engineering systems such that each may be installed in a proper manner, ensuring correct performance and allowing adequate maintenance access. All services shall be installed such that the positioning of ducts, pipes, cables, and all items of equipment avoid conflict. The Contractor's working drawings shall indicate any services co-ordination needs prior to submission to the Engineer for approval, tender drawing shall not be reissued as working drawings.

1.04 CONSTRUCTION DRAWINGS

A. Following approval of the Contractor's drawings by the Engineer, they shall constitute "Construction Drawings" and the E and M equipment shall be manufactured and installed in accordance with those approved drawings. The acceptance by the Engineer of any such drawing shall not relieve the Contractor of his responsibility under the Contract and shall not commit the Engineer or make the Engineer liable for any mistake of the manufacturer's deficiencies in strength or efficiency in operation of any part of any item for its specified purpose.

B. The Engineer reserves the right subsequently to amend or add to the Construction Drawings as may be necessary or expedient.

C. The Contractor shall provide to the Engineer, immediately after approval of each detailed drawing, one copy on transparent plastic film and two dye-line prints.

1.05 REGULATIONS

A. The installation materials and components shall comply with all relevant statutory instructions and regulations current at the date of tender, whether so detailed or not. In particular, the following departments must be consulted.

1. Standards & specifications issued by Ministry of Public Works.
2. British Standard Specifications
3. British Standard Code of Practice
4. UK IEE Regulations for Electrical Installation
5. US National Electrical Code
6. US National Electrical Safety Code
7. UK Chartered Institution of Building Services Engineers (CIBSE)
8. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
9. Water Regulations issued by Authority
10. Electrical Regulations issued by JEPCO
11. US Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

12. UK HVCA DW142 Ductwork specification.
13. US National Fire Protection Association Standards
14. IEE Regulations for Electrical Equipment of Buildings
15. Local Laws, Rules and Regulations
16. U.K BSRIA code for pipework flushing.
17. US Air Conditioning and Refrigeration Institute (ARI)
18 US American Society for Testing and Materials (ASTM)
19 US Air Movement and Control Association (AMCA)
20 US Underwrites Laboratories (UL)

1.06 CLIMATIC AND OPERATING CONDITIONS

A. City : Karak
Elevation : 1000 m above sea level
Temperature : See specification clauses.

1.07 WORKMANSHIP AND MATERIALS

A. The Contractor shall be responsible for ensuring that the components or each system are mutually compatible and integrated to form fully efficient systems complying with the Drawings and Specification. Corresponding parts throughout the Works shall be made to gauge and be interchangeable wherever possible. The Contractor shall, when required by the Engineer, prove interchangeability by the actual interchange of the various parts.

B. All articles and materials specified to conform to Jordanian, British and other standards shall be clearly and indelibly marked with the appropriate standard number specified except where marking is impracticable when relevant documents shall include this information.

C. All materials and workmanship shall be to the satisfaction of the Engineer. The Contractor shall maintain a competent supervising engineer and supervisors for each specialisation and for each section of the work on Site throughout the whole of the time to the completion of the works. The Engineer shall give prior approval to the appointment of this supervising engineer and shall have the authority to withdraw this approval at any time. No person shall be allowed to execute any type of work which is normally carried out by a skilled tradesman unless he is thoroughly experienced and proficient in the trade concerned. The Engineer shall have the authority to require any tradesman to demonstrate his proficiency to the satisfaction of the Engineer.

D. Where "stainless steel" is specified or used it shall have resistance to atmospheric corrosion and be of a grade to suit its particular use. Particular attention shall be made to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials of suitable relative hardness and surface finish and the applications of lubricants. Where bronze is specified or used it shall be zinc free.

E. All cast iron shall be of standard grey close-grained quality to BS 1452 Grade 14 or better. The structure of the casting shall be homogenous and free from non-metallic inclusions and other injurious defects. All surfaces of casting which are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.

F. Minor defects not exceeding 12.5% of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of larger defects and no repair welding of such defects shall be carried out without prior approval.

G. If the removal of metal for repair will reduce the stress-resisting cross-section of the casting by more than 25%, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25%, then that casting may be rejected.

H. Castings repaired by welding for major defects shall be stressed-relieved after such welding.

J. Non-destructive tests will be required for any casting containing defects whose extent cannot otherwise be judge, or to determine that repair welds have been properly made.

K. All major stress-bearing forgings shall be made to a standard specification which shall be submitted to the Engineer for approval before work is commenced. They shall be subject to internal examination and non-destructive tests for the detection of flaws and shall be heat treated for the relief of residual stresses. The name of the maker and particulars of the heat treatment proposed for each such forging shall be submitted to the Engineer. The Engineer may arranged for such forgings to be inspected at the place of manufacture with a representative of the Contractor.

L. Particular attention shall be paid to the prevention of corrosion due to the close proximity of dissimilar metals. Where it is necessary to use dissimilar metals in contact, they shall be selected so that the bimetallic corrosion is as low as possible. The publication by the UK H.M. Stationary Office entitled "Corrosion and its Prevention at Bimetallic Contacts" shall be used as a guide.

M. The use of iron and steel shall be avoided in instruments and electrical relays wherever possible. Steel screws, when used, shall be zinc, cadmium or chromium plated or, when plating is not possible owing to tolerance limitations, shall be of corrosion resisting steel. All woodscrews shall be of dull nickel plated brass or of other approved finish. Instrument screws (except those forming part of a magnetic circuit) shall be of brass or bronze. Spring shall be of non-rusting material, e.g., phosphor bronze or nickel silver, as far as possible. Pivots and other parts of which non-ferrous material is unsuitable shall be of an approved rustless steel where possible.

1.08 INSPECTION AND TESTS AT MANUFACTURER'S WORK

A. The Engineer and his duly authorised representative shall have at all reasonable times access to the Contractor's premises to inspect and examine the materials and workmanship of mechanical equipment being manufactured there, and if part of such equipment is being manufactured on other premises, the Contractors shall obtain for the Engineer and for his duly authorised representative permission to inspect as if that equipment was manufactured on the Contractor's own premises. Such inspection, examination or testing, if made, shall not relieve the Contractor from any obligation under the Contract.

B. All works, materials and the like rejected shall be corrected or replaced as necessary at the Contractor's own expense to the satisfaction of the Engineer.

C. Where the mechanical equipment is composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the manufacturer's works, to the relevant test or tests required.

D. The Contractor shall submit his proposed programme of tests for the Engineer' approval six weeks before the commencement of testing.

E. The aforementioned works tests carried out before delivery to the Site shall not in any way relieve the Contractor of completing satisfactory Site tests after erection as specified.

F. The Contractor shall give the Engineer reasonable notice, at least ten clear days in writing, of the date and the place at which any mechanical Equipment will be ready for testing as provided in the Contract and the Engineer shall thereupon at his discretion notify the Contractor of his intention either to release such part upon receipt of works tests certificates or of his intention to inspect such part. The Contractor shall forward to the Engineer six duly certified copies of all relevant test readings.

G. The Contractor shall provide, free of charge, such labour, materials, electricity, fuel, water, stores, apparatus, instruments and other things as may be reasonably demanded to carry out efficiently such tests of the mechanical equipment in accordance with the Contract, and shall provide facilities to the Engineer or to his authorised representative to accomplish such testing. Where inspection or testing is to be carried out at a Sub-contractor's works, a representative of the Contractor shall be present.

H. Works tests shall also be carried out such that due consideration is given to the Site conditions under which the mechanical equipment is required to function. The tests certificates shall give all details of such tests.

I. Specific performance works tests are described in the relevant Sections of Division 15, and include:

a) Sample performance testing of split units for airflow, heating and cooling & and noise emission.

1.09 CERTIFIED DRAWINGS

A. The Contractor shall be responsible for providing all "Certified" drawings from manufacturers of mechanical equipment, prior to their manufacture and installation. A "Certified' manufacturer's drawing shall mean a drawing which is prepared by a manufacturer as showing the exact dimensions and details of items of the mechanical equipment, as they will be supplied and installed in the Works.

1.10 SAMPLES

A. The Contractors shall provided a sample properly labelled of all fittings, valves, insulation, cocks, unions, grilles, dampers, switchgear, cables and other like accessories described in the Specification or as required by the Engineer.

1.11 PROTECTION AND CARE OF PLANT AND EQUIPMENT

A. All mechanical equipment shall be packed in robust containers to prevent damage and mishandling during transport to Site. Before dispatch from works all mechanical equipment shall be thoroughly cleaned, protected against damage, deterioration, corrosion and ingress of dirt and packed and protected suitable for prolonged storage in a humid and saline atmosphere.

During storage and erection at the Site, the mechanical equipment shall be kept clean and free from dirt and debris, and water shall not be allowed to remain in any pockets of the equipment. All items of mechanical equipment shall be stored clear to the ground on suitable timbers to the approval of the Engineer.

All mechanical equipment, particularly electrical and other sensitive instrumentation shall at all times be protected so that it is not subject to damage by rainwater, moisture, dust, etc., from any source. Mechanical equipment which may be damaged by heat or sun shall be protected accordingly. All open piped ends and duct ends whether installed or in store shall be fitted with plastic caps or suitable protective covering.

1.12 GUARDS

A. A guard shall be provided for all open unprotected intakes to axial fans, centrifugal flow fans, for V-belt drives or in any position required by the UK Factories Act.

Fan guards shall be manufactured by the fan maker, of galvanised steel wire mesh, not greater than 25mm attached to a rigid galvanised steel rod framework.

Cleaning: The Contractor shall be responsible for cleaning all mechanical equipment at all times to the satisfaction of the Engineer. The cleaning shall be carried out notwithstanding the fact that the installation or any part thereof may be in use of partial use within the premises in occupation by others. A Certificate of Completion will not be issued until the Engineer is satisfied that all dirt, jointing materials and other extraneous and injurious materials have been removed.

1.13 AIR CONDITIONED STORES

A. The Contractor shall provide air conditioned site stores for all goods which deteriorate when subjected to the site climatic conditions detailed. The contractor will adhere strictly to the Manufacturer's instructions with regard to storage temperatures for all materials being used for the construction of this project.

1.14 PAINTING

A. The preparation, painting and treatment of mechanical equipment surfaces shall be in accordance with relevant items in Division 15.

B. Full details of the manufacturer's standard finishes shall be given to the Engineer for his approval prior to manufacturer. Special care shall be taken to ensure standard finishes are suitable for the particular conditions applicable to the individual items of plant.

C. Any damage to paintwork which occurs shall be made good by the Contractor at his own cost to the satisfaction of the Engineer.

D. The interiors of control panels shall be finished white enamel paint (two coats) and shall comply with the appropriate BS for enamel finish and the exteriors of such panels shall be of BS Specification colour as specified by the Engineer to give a minimum reflection value of 42%. Instruments shall be finished dull black and control handles, push button and similar fittings shall be chromium plated or otherwise durably finished to the approval of the Engineer.

E. All bright metal parts shall be covered before despatch with an approved protective compound and protected adequately during delivery to Site. After erection these parts shall be cleaned with a correct solvent and polished bright where required.

F. Machined mating surfaces such as gear teeth, etc., shall be coated with a thick layer of grease. Other machined surfaces shall be given a coat of rust-preventing paint which shall be readily removable when required.

G. Where it is the usual practice of the manufacturer of special items such as pumps, compressors, electric motors, gear boxes, switch gear, etc., to apply a high standard of protective enamel paintwork in the shops before despatch, this will be acceptable provided any subsequent damage to the paintwork is made good by the Contractor, at his own cost. The preferred finish is light grey.

H. The inside of outdoor control cubicles, cabinets, etc., where condensation is liable to occur, shall be coated with an approved anti-condensation composition.

J. The Contractor shall obtain the paint manufacturer's guarantee that each coat of paint is compatible with the previous and subsequent coats so that peeling, flaking and other faults do not occur.

K. The Contractor shall include for painting all pipes, ducts, flange edges, etc., prior to their being insulated.

L. Final decoration of exposed pipework, brackets and ductwork shall be carried out in accordance with standards.

1.15 MANUFACTURER'S NAMEPLATES

A. Nameplates: Each item of mechanical equipment and plant shall have the manufacturer's name or trademark on a corrosion-resistant nameplate securely affixed in a conspicuous place. The manufacturer's name or trademark may be cast integrally with stamped or otherwise permanently marked upon the item of the equipment. The nameplate shall show the equipment reference number, date of manufacture and the capacity. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplates.

1.16 LABELS

A. Identification labels of plastic laminate or similar approved materials engraved black on white unless otherwise agreed, with not less than 5mm "line" style letters shall be fixed on or adjacent to all controls, switches and distribution gear, by means of at least two brass screws. Socket outlets of all voltages shall be similarly identified or engraved.

B. The labels shall bear the identification shown on the Drawings, such as indication, designation, function and, where necessary, phase, voltage, current, frequency, pressure and temperature. All labels shall be in Arabic and English.

1.17 LUBRICATION

A. A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer for approval before incorporation in the instruction manuals. In the case of grease lubricated roller type bearings for electric motors, a lithium base grease is preferred.

B. Where lubrication is affected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent for this purpose, means more than once weekly and grease systems having shorter periods between greasing should be avoided. Where necessary for accessibility, grease nipples shall be placed at the end of extension piping

and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. Button head type nipples shall be of the same size and type for every part of the plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil

C. Where more than one special grease is required a grease gun for each special type shall be supplied and permanently labelled.

D. Oil sumps shall be fitted with oil level indicators of the sight glass type, or where this is not practical, with dipsticks. The indicators shall show the level of all temperatures likely to be experienced in service. The normal, maximum and minimum levels at 30°C shall be clearly visible in the sight glass type from the normal access floor to the particular item of plant, and they shall be easily dismantled.

E. All sight glasses shall be firmly held and enclosed in metal protection in such a manner that they cannot be accidentally damaged.

F. All lubrication systems shall be designed so as not to present a fire hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into current contact with any electrical equipment, heated surfaces or any other potential source of fire.

G. The Contractor shall supply flushing oil for each lubrication system when an item of plant is ready for preliminary running and a sufficient quantity of the approved lubricants for setting to work and for the commercial operation for one year after the relevant Certification of Completion has been issued.

1.18 SPECIAL TOOLS

A. The Contractor shall supply two complete sets of any special tools necessary for the operation, maintenance and dismantling of the mechanical equipment. The Contractor shall supply wall-mounted strongboxes, each fitted with a suitable lock and two keys, and located near the item of mechanical equipment for which they will be used. Such tools shall not be used by the Contractor during the erection of the mechanical equipment.

1.19 SUNDRY BUILDERS WORK IN CONNECTION WITH SERVICES

A. The Contractor shall include in his prices for drilling, rawbolting, plugging, screwing and nailing of all brackets, hangers, for all pipework, ductwork conduit, cable tray, cable trunking and cable supports. The Contractor shall also include for supplying all brackets, hangers and supports as necessary.

1.20 NOISE

A. The Contractor shall provide a quiet installation. All items of mechanical equipment shown on the Drawings shall be carefully chosen with a view to silent operation. The recommendations in BS 5720 and BSCP 3 Chapter III

shall be followed wherever necessary. The Contractor shall prepare detailed noise level calculations to indicate the anticipated noise levels in all critical areas.

B. All possible steps shall be taken, (e.g. by the use of sound insulation, anti-vibration mountings, and careful design of motors, fans, ducts, bends, dampers, grilles and other equipment) to reduce the noise produced by the mechanical equipment.

C. The Contractor shall determine the noise levels of all primary mechanical equipments before proceeding with manufacture and submit sound power levels of such Equipment to the Engineer for approval before manufacture is commenced.

1.21 ANTI-VIBRATION MOUNTINGS AND SOUND ABSORPTION

A. The Contractor shall provide and fix all mechanical equipment to prevent noise and the transmission of vibration through the structures.

B. All fans, motors, compressors and other items, as appropriate, shall be mounted on resilient mountings in such a manner that the plant foundations are isolated from the floor or structure. In addition, all rotating plant shall be statically and dynamically balanced.

C. Mechanical vibration shall be eliminated by the use of anti-vibration mountings and flexible connections to ensure an isolation efficiency of 95% from the building structure except where defined otherwise on the Drawings or in the Specification.

D. Spring type anti-vibration mountings shall be the captive partially encased and restrained type to prevent lateral movement.

1.22 AS BUILT DRAWINGS

A. Thirty days prior to the date of the handing over certificate, the Contractor shall provide for approval "as built" record drawings of the whole works.

B. The Drawings shall include the following:-

1. General arrangements of all services to a scale of not less than 1:50.

2. Detailed layouts of plantrooms and similar spaces to a scale of not less than 1:20.

3. Schedules of all plant and crossed referenced equipment to the maintenance manual.

4. All equipment and control wiring diagrams together with specialist system i.e. public address, fire alarms, etc.

5. These may be produced separately or included with the general distribution diagrams.

6. Indicate with accurate dimensions, sizes and positions of all plant, equipment and valves together with all inspection points and test positions. All plants to have indicated manufacturer's name, model and type number also cross referenced to maintenance manual.

7. Fully indicate all ductwork, pipework, sizes and positions of all plant equipment and valves together with all inspection points and test positions. All plant to have indicated manufacturer's name model and type number also cross referenced to maintenance manual.

8. Show the disposition and depth of all cables, pipes, ducts, buried direct in the ground and taken at intervals where cable increase or decrease in number/size and at every point where the services enter into or depart from ducts or buildings.

9. Indicate the number, sizes and services for every cable, duct, pipe, for every service within each building. Circuit lists for every distribution board shall be entered on to the relevant drawings and such lists shall agree with the list fixed within the distribution board door.

10. Show clearly on site drawings all the new buildings together with all other existing buildings and other permanent features with dimensions between such buildings and cables, pipes, ducts, etc. clearly marked, together with installed backfill and surround to each services.

11. Indicate all equipment and control wiring diagrams together with all specialist systems i.e. public address, fire alarm, etc. Diagrams must be co-ordinated and show all required interblocks etc. between systems or components.

12. Show clearly all plumbing and drainage and setting out dimensions for all drainage pipework and manholes both within the building throughout the site, together with drainage pipework backfill, or surround in each location. A schedule shall be included to indicate each manhole size, cover size, invert level and ground level.

C. The symbol used for each service for all as built drawings shall be shown on separate drawings.

D. In order to achieved accurate as built drawings, all relevant information relating to the mechanical works shall be entered onto prints supplied immediately after the work has been carried out. The marked up prints shall be available for inspection at the Contractor's site office at any reasonable time during the progress of the works.

E. All service routes, intersections and joints shown on the prints and finally recorded shall be actually physically measured from permanent features and accurate distances shall be shown on the Drawings.

F. In addition to the as built drawings, the Contractor shall obtain and provide two sets of all manufacturer's detailed drawings for all items of plant, equipment, apparatus and materials. These drawings shall be suitably titled and have drawing reference numbers added.

G. The Contractor shall provide two copies for all as built drawings for review comments and approval. Upon receiving approval in writing from the Engineer, or his representative, the Contractor shall provide one negative copy of each approved as built drawing and bind one set of prints into each of 6 No. copies of the operating instructions specified in clause 1.23.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The working, operating and maintenance instruction shall be prepared in draft as soon as the working drawings are in hand and shall take the form of a manual in which fully detailed information relating to the maintenance and operation of the complete installation and its component parts is presented.

a) Overall general description of the complete equipment installed together with the method of functioning.

b) Full technical descriptions of each and every item of equipment, including the electrical circuit details as applicable.

c) Operating procedures for each section of the works and each individual item of equipment or plant.

d) Planned maintenance schedules for the installation and its component parts to include commissioning performance details and measurements.

e) Schedule of components comprising each and every item of equipment including manufacturer's name, description and part number of each component.

f) A copy of the manufacturer's literature, describing each item of equipment, plant fittings and accessory type used throughout the installation. This literature shall list the technical data available, together with catalogue list numbers for replacement purposes.

g) Generally all drawings must be arranged to flood out from their position and be entirely visible when any part of the manual is being read. They shall be printed on linen backed paper.

h) Each section shall be encased in a loose leaf ring binder covered in plastic material of an approved colour and of a type which shall be flat when open.

i) The Contractor shall include for the preparation and supply of six copies of the above operating and maintenance instructions for each section after all details have been approved by the Engineer.

j) Electric transfer of "As Built" drawings shall be provided as required by the Engineer.

1.24 INSTRUCTION AND TRAINING

The Contractor shall be responsible for the provision of suitably qualified personnel for the instruction and supervision of the Employer's staff at Site in the operation and routine maintenance of all mechanical equipment and associate works. Unless specified to the contrary in the specific technical clauses in Division 15 instruction and training shall be for periods of six hours daily for two days after the satisfactory commissioning of the installation and as necessary, after each subsequent commissioning of a system or part thereof.

1.25 SPARES AND CONSUMABLES

A. A list of spares and consumables for 1 years operation for every item of plant and system shall be furnished by the Contractor at the time of tendering.

1.26 MOCK-UPS

A. The Contractor shall provide mechanical equipment to allow full Architectural Mock-ups to be built as described elsewhere in the specification.

PART 2 PRODUCTS

2.01 Not Used.

PART 3 EXECUTION

3.01 Not Used.

END OF SECTION 15010