DETAILED WORKS INFORMATION FOR SUPPLY AND INSTALLATION OF THE MECHANICAL WORKS

REFURBISHMENT OF QUEENS WAREHOUSE

TNPA ENGINEERING DESIGN: SIGNATORIES

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DETAILED WORKS INFORMATION FOR SUPPLY AND INSTALLATION OF THE MECHANICAL WORKS

This works information outlines general requirements for the execution of contracts and sets for materials, equipment, workmanship, quality control, testing and commissioning and guarantee of mechanical building services installations.

If any clause of the stipulation contained herein is in conflict with the relevant contract/subcontract, pertaining to the installation or in conflict with the project specification then both the latter shall have precedence.

1. MECHANICAL WORKS: HVAC, WATER RETICULATION, AND FIRE PROTECTION

1.1 GENERAL REQUIREMENTS

1.1.1 For the purposes of technical decision making in terms of this contract the following processes shall apply:

1.1.1.1 The *Contractor* shall submit an FEQ in accordance with the NEC3 FEQ process to the Project Manager and NEC Supervisor for the Engineers action and attention.

1.1.1.2 The responsibility for the decision making resides with the Engineer and shall be communicated in terms of contractual instruction by the Project Manager and/or NEC Supervisor.

1.1.1.3 Under no circumstances shall technical decisions be taken without the approval of the responsible TNPA engineer. Any reference hereinafter to "Engineer" or "acceptance by Engineer" shall be through the above communication protocol.

1.1.2 This installation shall be suitable in all respects for operation under the atmospheric conditions and electricity supply as outlined in the schedules. The onus is on the *Contractor* to ascertain any other local conditions or peculiarities which might affect the working of the plant, and no

allowance in price or standards of materials or workmanship shall be made for any ignorance on the part of the *Contractor* in this respect.

1.1.3 All materials and workmanship supplied under this contract shall be new and of the highest quality. Design and installation work shall be done in accordance with the best modern engineering practice. The Engineer shall have the right to reject and demand satisfactory replacement at the *Contractor's* cost, or any part of it, which in his opinion, does not conform to the highest standards of material and workmanship. The equipment shall be suitable for continuous duty operation, and it is essential that all installations shall be capable of operating continuously and satisfactorily over such periods.

1.1.4 The *Contractors* shall submit the completed Appendix 1 and Appendix 2 as part of the documents listed in the returnable schedule. Failure to submit the documents will be reason for disqualification form the tender bid.

1.2 SCOPE OF WORK

1.2.1 This specification covers the manufacture, supply, delivery, installation and commissioning, testing, and handing over in complete working order, ready for immediate use and subsequent maintenance as per the NEC contract.

1.2.2 The principal items of work include the Supply-Install Packages which will include the following system, and which will entail supply and installation, testing, commissioning and handover of the following systems:

1.2.2.1 HVAC system for Queens Warehouse (Supply-Install Package)

i. A single wall split unit at reception area.

ii. Removal and replacement of existing extractor fans at the ground floor male, female, and paraplegic toilets as well as the kitchen.

iii. Installation of new extractor fans in the new male and female change rooms as well as the new kitchen.

iv. Removal and replacement of existing extractor fans at the first-floor male, female and paraplegic toilets.

v. Removal and replacement of existing extractor fans at the second-floor male, female and paraplegic toilets as well as the kitchens.

vi. Cleaning of wall louvre on the ground floor where existing ductwork has been removed.

vii. Removal of air extraction and fresh air supply ductwork in the ground floor level and hand it over to the Employer.

viii. Install new glazing louvres to seal the openings left after the removal of ductwork on the ground floor. Reuse existing louvres as indicated for reuse in the approved drawings, and supply and install new louvres as specified in the drawings.

ix. Remove and replace the complete HVAC system in the Queen Elizabeth boardroom, kitchen, and cleaner's room in accordance with the approved drawings. The work shall include provision of fresh air supply, extraction, and air conditioning systems.

x. Supply, install, commissioning of a new air conditioning system in the new boardrooms on first floor.

xi. Supply, install, commissioning of new water reticulation system in the new kitchen on first floor.

xii. Extend the existing fire detection system to cover the new boardrooms on the first floor and programme the existing fire panel.

xiii. Remove and re-install all the fire detection systems across all floors where ceiling is being removed.

xiv. Removal and reuse of the ceiling diffusers and ceiling grilles in all the boardrooms and property offices.

xv. Protect the first-floor supply vents and return air grilles from dust that is expected to accumulate during the replacement of floor carpets, using appropriate covers that will be approved by the employer.

xvi. Make all the necessary wall and window openings as specified in the HVAC drawings.

1.2.2.2 Fire Protection System

i. Remove and reuse all fire extinguishers and fire blankets as indicated on the approved fire drawings. All extinguishers and fire blankets shall be safely stored in a secure manner to prevent any damage.

ii. Protect the fire hose reels, manual call points, and all other fire equipment specified in the approved fire drawings from dust that is expected to accumulate during the replacement of floor carpets using appropriate covers approved by the Employer.

iii. Removal and replacement of all fire signage as indicated on the drawings.

iv. Removal and reuse of all ceiling mounted fire detection components such as detectors and sounders.

1.2.2.3 Water reticulation

i. All the plumbing pipework work for the new ground floor change room together with all required fittings as well as the new kitchen.

ii. 200L hot water geyser for hot water supply to showers at the new ground floor change rooms.

iii. 100L hot water geyser for hot water supply to existing shower located in the first floor west side male toilets

iv. All requirements laid down by the local authority, sans 10252 and sans 10254 codes of practice must be strictly adhered to.

v. All pipe runs should be flushed, fastened and pressure tested, prior to the application of any terminal fittings.

vi. Underground piping to be h.d.p.e. class 12. At the points where the service pipe enters the building it shall change to copper that conforms with SANS 460, class 1

vii. Hot water geyser to be as per provided technical specification with all necessary drain safety valves, etc. Provide all necessary electrical points, isolation boxes, drip tray and fittings etc.

viii. Water pressure to be tested prior to ordering of flush masters. All valves to be fully accessible for maintenance.

ix. Cold water taps to be on the right hand side & hot water taps on the left when facing fitting.

1.3 VISIT TO SITE

1.3.1 *Contractors* must acquaint themselves with local site conditions such as access area available on site, type of ground, space available for on-site fabrication, storage, transport, loading and unloading facilities, scaffolding, tackles and tools needed, as no claims by the *Contractor*, which may arise from ignorance of the site conditions, shall be considered.

1.4 MATERIALS AND WORKMANSHIP

1.4.1 The contract works shall be executed in accordance with the specified standards and level of workmanship, to the satisfaction of the Engineer.

1.4.2 All materials shall be of the quality specified and the *Contractor* shall, upon request of the Engineer, furnish him with proof to his satisfaction that the materials are of the specified quality. The Engineer is not responsible for Quality Assurance on behalf of the *Contractor* but shall be entitled to condemn unsatisfactory work.

1.4.3 All materials and equipment used for the installations shall be new and undamaged. The *Contractor* shall, if requested by the Engineer, provide samples of material and equipment for approval. If judged necessary by the Engineer, such samples may only be returned after the completion of the installation, in order to ensure that the quality of the installed product is the same as that of the approved sample.

1.5 DRAWINGS

1.5.1 Workshop Drawings

1.5.1.1 Preparation of complete shop drawings is the responsibility of the *Contractor*. The shop drawings must be prepared on the basis of:

i. The latest Architect's, Structural Engineer's, and Electrical Engineer's drawings regarding co-ordination and layout.

ii. Actual equipment offered in the Tender and approved by the Engineer. No work may be put in hand before the relevant shop drawings have been reviewed by the Engineer for NEC3 acceptance. The Engineer's responsibility in this regard is limited to checking conformance with the design and specification and co-ordination with other disciplines where necessary. This does not absolve the *Contractor* of any responsibility in terms of the Subcontract or for errors or omissions in the shop drawings.

1.5.2 Builders Work Drawings

1.5.2.1 Structural Openings

i. The Engineer has arranged for all openings in concrete structure to be incorporated in the structural drawings. The Contractor is responsible to check that all openings shown on the structural drawings are correctly sized and positioned to suit the installation. Any discrepancies must be brought to the attention of the Engineer through the NEC FEQ process before concrete is cast.

1.5.2.2 Openings in Brickwork

i. The Contractor shall show all openings in brickwork, windows, and other finishes on layout drawings in such a way as to constitute a clear instruction to others.

1.5.2.3 Equipment Bases

i. The Contractor shall be responsible for designing and providing detailed Builder's Work drawings for all plinths, equipment bases as per the equipment selected.

1.5.3 Noise and Attenuation

1.5.3.1 In respect of noise control and attenuation the Contractor shall be responsible for the supply and installation of all equipment as specified by the Engineer, including sound attenuators, spring mounts, mass bases, flexible connections etc., to limit undesirable noise generation and transmission. Correct selection of the items listed below shall be the responsibility of the Contractor together with the Specialist Supplier:

i. Spring Mounts.

ii. Vibration Isolating pads.

iii. Spring Hangers and Supports for Pipes.

iv. Vibration Isolating Hangers and Supports for Pipes.

v. Flexible connections.

1.5.3.2 The *Contractor* shall also be responsible to ensure that where pipes pass through concrete, brick or other structural members and finishes. This is achieved without transmission of noise and vibration.

1.5.4 Alternatives and Main Offer

1.5.4.1 The main tender price must include for the equipment specified herein, under the heading of Allowed in Tender. This does not necessarily indicate a general preference for the specified equipment but serves the purpose of ensuring that all *Contractors* include for the same major equipment in their Tender Price. Generally the specified equipment will be of the quality and in the price range, deemed appropriate for the project. All alternatives to the specified equipment shall be only considered once the tender has been awarded. Any alternative to the proposed brand shall be submitted to the Engineer though the NEC FEQ process for acceptance. The *Contractor* shall detail the equipment proposed, the reason for the proposal and the incidental extra costs or savings associated. Where the alternatives do not comply with the specification or specified equipment in full, all deviations must be listed in detail. When evaluating alternatives, the Engineer shall take into account factors such as technical compliance, quality of product, Client preference, track record, service facilities and spares back-up and availability rather than just cost savings.

1.6 RESPONSIBILITIES OF THE CONTRACTOR

1.6.1 Sub-Contractors

1.6.1.1 Any work which Contractors intend subcontracting must be listed in the Tender showing the names of intended *Contractor*. If these are deemed suitable then no deviation will be permitted without the authorization of the Engineer.

1.6.2 Ordering of Equipment and Materials

1.6.2.1 The *Contractor* shall be responsible to ensure that the project programme is adhered to and that no delays are caused by late deliveries of equipment and materials. All other activities which must proceed placing of orders must be taken into account especially long-lead items when the *Contractor* schedules his activities.

1.6.3 Storage of Materials and Equipment

1.6.3.1 The *Contractor* shall be responsible for the proper and safe storage of all materials and equipment on site to ensure protection against the elements, damage by impact, dirt, builder's rubble dust and theft etc.

1.6.4 Protection of the Works

1.6.4.1 The *Contractor* shall programme his work to avoid damage by other Trades and shall be responsible for protection of the works against such damage until handover to the Client.

1.6.5 Accessibility

1.6.5.1 The *Contractor* shall plan suitable accessibility for thermometers, gauges, controls, dampers and other devices which require reading adjustment, inspection, repair removal or replacement.

1.6.6 Weather Proofing

1.6.6.1 All outdoor equipment shall be weatherproof and corrosion resistant including minor items such as screws fixers, brackets, etc.

1.6.6.2 The IP rating for waterproofing must be approved by the Engineer.

1.7 REFERENCE SPECIFICATION AND STANDARDS

1.7.1 The latest revision of any Specification, Code or Standard referred to in this specification, shall be applicable.

1.7.2 Where a specification or standard is not specifically referred to, it shall be assumed that the relevant SANS, ISO, BSS, DIN or equivalent American standard, listed in order of preference shall apply.

1.7.3 The SI ("Le Systeme International d' Unites") – Metric System of Units shall apply. Refer to SANS – M33A: The International Metric System: Guide to the use of the SI in South Africa.

1.7.4 The entire new installation shall be carried out in accordance with the standards in **Table 1** and other specification in **Table 2**:

Table 1: South African National Standards

Standard No.	Description
SANS 10400	The Application of the National Building Regulations
SANS 10252-1	Water Supply and Drainage for Buildings-Part 1: Water Supply Installations for Buildings
SANS 10252-2	Water Supply Installations for Buildings-Part 2: Drainage Installations for Buildings
SANS 10254	The Installation, Maintenance, Replacement and Repair of Fixed Electric Storage Water Heating Systems
SANS 62	Steel pipes - Part 1 and 2
SANS 151	Fixed Electric Storage Water Heaters
SANS 10142	Code of Practice for the Wiring of Premises
SANS 1424	Filters for use in Air-conditioning and General Ventilation

Table 2: Other Specifications

Code / Reference No.	Description
EEAM-Q-006	Structural steelwork
EEAM-Q-008	Corrosion protection
EEAM-Q-009	Quality management
EEAM-Q-013	Commissioning and handover
EEAM-Q-028 M	Specific requirements and conditions (mechanical)

1.8 DESIGN CONDITIONS

1.8.1 The following design conditions shall be used in designing the systems for this project:

- External Conditions:
  - Summer ambient : 31.7 °C Dry Bulb – 24.9 °C Wet bulb
  - Winter ambient : 26.2 °C Dry Bulb – 14.5 °C Wet Bulb
- Internal Conditions:
  - Summer : 23 °C Dry bulb – 55 % Relative Humidity
  - Winter : 23 °C Dry bulb – Humidity not controlled
- Design Conditions:
  - Lighting load : 10 W/m^2
  - Glass shade coefficient : 0.46
  - Ventilation : as per SANS 10400
  - U' values – Glass (all facades) : 3.7 watt/m^2/K
  - Outside walls (all facades) : 2.211 watt/m^2/°C
  - Partitions : 1.256 watt/m^2/°C
  - Concrete slab : 2 watt/m^2/°C

1.8.2 The Contractor shall test, commission and adjust the air conditioning and ventilation installations such that it will maintain the inside design conditions specified above, subject to the capacity limits hereinafter specified during hours of operation

1.8.3 Noise levels

1.8.3.1 Maximum noise levels caused by the operation of the air-conditioning system and ventilation shall comply with the OHS Act 85 of 1993 and all other relevant regulations.

1.8.3.2 The specified noise levels shall be those that are read at a distance of not more than 2 metres from any air outlet, return air grille or opening.

1.9 TECHNICAL REQUIREMENTS

1.9.1 Erection of Equipment

1.9.1.1 The *Contractor* shall allow for a complete installation, including the provision of mobile cranes, air compressors, lifting tackle, measuring equipment, precision levels, and all other special or regular tools and equipment that may be needed to complete the entire installation in accordance with the specification.

1.9.1.2 The *Contractor* will be responsible for any damage caused to buildings, equipment, etc. during the course of the erection of the equipment.

1.9.2 Equipment Plinths

1.9.2.1 Plinths as specified hereunder shall not be confused with any form of inertia or anti-vibration base.

1.9.2.2 Plinths shall be provided for all mechanical equipment. Plinths cast on concrete surfaces shall protrude at least 100mm above floor levels and depending on the position of the vibration mountings, shall be at least 300mm wider or longer than the inertia bases mounted on top (Where applicable).

1.9.2.3 Plinths for equipment which do not need inertia bases or plinths for inertia bases with recessed vibration mountings shall be of the same size as the equipment or bases mounted on top.

1.9.2.4 The Plinths shall be designed to be able to support the weight of the equipment being fixed on them and the surface shall be completely horizontal level and even.

1.9.3 Holding Down Bolts and Bolts for Equipment

1.9.3.1 The *Contractor* shall be responsible for the supply of all necessary holding down bolts for the machines supplied by him. He shall also supply all bolts necessary for assembling all the equipment supplied by him.

1.9.3.2 Holding down bolts shall preferably be cast into concrete bases when the bases are being cast. All bolts shall, in this instance, be provided with hot dip zinc galvanised sheet metal sleeves approximately three times the diameter of the bolt and projecting a minimum of four-bolt diameters below the surface of the concrete. This sleeve must be kept free of concrete until the final grouting takes place.

1.9.3.3 Where galvanised bolts are called for, they shall be fully galvanised all over. No re-cutting of threads will be permitted after galvanising. All nuts must run freely on the threads.

1.9.4 Packing of Equipment

1.9.4.1 All base plates and steel work shall be suitably packed with steel packs to ensure that they are true to level, line, and grade. The thickness of packing shall be such as to allow for not less than 25mm, and not more than 50mm of grout under all base plates or steel work. Packings shall be of suitable size to support the base plates, and one pack must be situated immediately on each side of each holding down bolt as well as in any position as may be required in order to adequately support the base plates and its superimposed load.

1.9.4.2 All packs shall be as near as possible to the exact height in one thick piece. Thinner shims may be used for final adjustments, but large piles of thin shims will not be accepted. All packs must be of parallel shims. Taper packs or wedges will not be accepted. Packs must be bedded on a flat and smooth area on the surface of the concrete foundation. Packs resting on rough concrete will be rejected.

1.9.4.3 After final levelling and lining up, it is essential that all packs are tight. Loose packs will be rejected.

1.9.4.4 No shims will be permitted between a machine base and plate and the machine's feet except as mentioned hereinafter.

1.9.5 Welding

1.9.5.1 Welding shall be carried out in accordance with the current edition of SANS 10044 where applicable.

1.9.5.2 All welded filler or butt joints shall be free from porosity, cavities and entrapped slag.

1.9.5.3 The joints in the weld run, where welding has been recommended, shall be as smooth as possible and shall show no pronounced hump or crater in the weld surface.

1.9.5.4 The profile of the weld shall be uniform, of approximately equal leg length and free from overlap at the toe of the weld. Unless otherwise specified the surface shall be either flat or slightly convex in the case of fillet welds and with reinforcement of not

more than 3mm in the case of butt welds. The weld face shall be uniform in appearance throughout its length.

1.9.5.5 Filler metal electrodes shall be of an approved type for the material being used and shall be kept in a dry condition. All electrodes shall conform to the latest edition of SANS 2560.

1.9.5.6 Only welders in possession of a valid approved competence certificate shall be employed.

1.9.5.7 All welds must show proper fusion.

1.9.6 Galvanising

1.9.6.1 All fabricated mild steel sections, pipework, fixtures and fittings shall be hot dip zinc galvanised to comply with SANS 62 and SANS 1182:2013 and shall be of minimum mean coating thickness 200µm.

1.9.6.2 Items to be galvanised shall be entirely prefabricated and then dismantled in sections for galvanising. No cutting of threads or welding will be accepted after galvanising.

1.9.6.3 Mild steel plate and sections shall be of good commercial quality, or higher grades, best suited for galvanising. The materials shall be free from slag or coarse laminations, fine fissures and rolled-in impurities.

1.9.6.4 Welding flux shall be chipped away and all welds wire brushed before galvanising.

1.9.6.5 The surface to be galvanised shall be free from paint, oil, grease and similar impurities.

1.9.6.6 All exposed surfaces including welds shall be thoroughly sand blasted prior to galvanising.

1.9.6.7 The Project Manager Representative reserves the right to inspect all steel components before galvanising and shall have the right to reject or ask for remedial treatment of any material which is considered to be unsuitable. This applies particularly to welds.

1.9.6.8 The hot dip galvanizing bath shall primarily contain molten zinc. The total of the other elements (as identified in ISO 752, EN 1179 or EN 13283, excluding tin and iron) in the molten zinc shall not exceed 1,5% by mass.

1.9.6.9 The significant surface(s) of all the hot dip galvanized article(s), when first examined by normal or corrected vision from a distance of not less than 1 m, shall be free from nodules, blisters (i.e. raised areas without solid metal beneath), roughness and sharp

points (if either can cause injury) and uncoated areas. Flux residues shall not be permitted. Lumps and zinc ash shall not be permitted where they might affect the intended use of the hot dip galvanized article or its corrosion resistance requirement.

1.9.6.10 Articles that fail visual inspection of the galvanising shall be renovated according to the criteria mentioned in clause 6.3 of SANS 121:2011.

1.9.7 Vibration Control

1.9.7.1 **Vibration Isolation:** Proper provisions shall be made in the foundations and mountings of all equipment capable of transmitting vibration forces to its environment, whether local or remote, (As is the case with pipes) for vibration isolation.

Selection of vibration isolation equipment and in particular, mountings for equipment and machines, shall be done with due regard to the forcing frequency of the driven machinery and the mounted natural resonant frequency of the machine.

In the case of installation of equipment on upper floors, suspended floors, roofs etc. it is of prime importance that floor stiffness, floor, deflection and natural frequency of the floor be taken into consideration to ensure that resonant conditions cannot occur.

Driven machinery and isolator deflections shall be carefully selected in these applications.

Should added mass inertia blocks be required to comply with these vibration isolation requirements, proper provision shall be made at tender stage for the provision of such.

1.9.7.2 **Damping:** Where static deflections in excess of 8mm are indicated, steel springs shall be employed incorporating acoustic sound pads in series with the spring.

The horizontal stiffness of the springs shall not exceed that in the vertical, in particular for systems mounted at vertical frequencies below 5Hz.

Low frequency mounts shall incorporate rubber snubbers to accommodate extreme horizontal or vertical motions such as can occur near resonance during start up.

The snubbers shall however not be relied upon to provide the necessary horizontal stability of the machine in normal operational conditions. Spring layouts and inertia blocks shall be employed to avoid this situation.

For static deflections below 8mm, rubber in sheer mounts may be used provided the frequency is above 6Hz.

For small static deflections less than 4mm and particularly for high-speed machines and general acoustic isolation, ribbed rubber neoprene composite pads may be employed subject to the specified requirements.

Sufficient stability and damping shall be incorporated in the mountings to minimise the movement of the machine during start up or changes in the operating conditions.

The selection of mounts shall take proper cognisance of unequal distribution of the mounting weight of equipment and rotational and/or pressure forces acting thereon.

1.9.8 Painting

1.9.8.1 The paint colour scheme shall comply fully with the SANS 10140 requirements.

1.9.8.2 All steel surfaces that need to be painted shall be prepared as per SANS 8501-3 and SANS 10322.

1.9.8.3 All other exposed metal parts such as piping, pipe lagging, fittings, dampers, fans, control panels, steelwork, etc. shall be cleaned, primed, undercoated and finished in a high-quality gloss paint of approved colour.

1.9.8.4 All external equipment exposed to the weather must be cleaned, primed and painted with two coats of epoxy paint.

1.9.8.5 The lagged surface of calorifier, headers and pipes shall be primed, undercoated and finished in a high-quality gross of approved colour. Unlagged steam piping shall be painted with heat resistant paint.

1.9.9 Fans

1.9.9.1 The fans shall be selected to comply with the ventilation requirements of SANS 10400.

1.9.9.2 All fans shall be selected for the highest possible efficiency and comply with the noise criteria specified.

1.9.9.3 Fans shall be installed with anti-vibration mountings to match the fan characteristics.

1.9.9.4 Fans shall be suitable for continuous operation in high humidity conditions.

1.9.9.5 All fan Casings and fasteners shall be hit dip zinc galvanised steel.

1.9.10 Grilles/Diffusers

1.9.10.1 Door grilles shall be manufactured from aluminium extruded sections, natural anodised 9E6-C-0)

1.9.11 Louvres

1.9.11.1 The weather resistant louvres shall be of a specification equal or similar accepted to that provided in Appendix 1 and shall be located as per the positions denoted on the drawings.

1.9.11.2 The louvers frames and blades shall be constructed of extruded aluminium section, natural anodised (E6-C-0)

1.9.11.3 Top and bottom blades shall be fitted flush with the frame and smooth without grooves, channels or recess where dirt or water can collect.

1.9.11.4 The louvers shall be fitted with 6mm opening size galvanised metal mesh screen.

1.10 TESTING, COMMISSIONING & BALANCING

1.10.1.1 Shall be carried out by an independent firm employing competent technician familiar with the testing, adjusting and balancing of air-conditioning systems in the presence of Engineers from Transnet Capital Projects. Such firms shall forward all test results to the Engineer and Selected Subcontractor, for approval.

1.10.1.2 Commissioning of the class 100 and class 1000 units shall be carried out by the manufacturer of the units, to ensure that systems performs and designed and specified duties and functions and that all temperature and control monitoring / adjustment are in place and also functioning correctly.

1.10.1.3 Testing, adjusting and balancing of the systems shall generally be in accordance with chapter 37 of 2008 ASHRAE HANDBOOK (HVAC Systems and Equipment).

1.11 OPERATING & MAINTENANCE MANUALS

1.11.1.1 Five sets of Operating and Maintenance Manuals shall be in the form as suggested in Chapter 38 of 2007 ASHRAE HANDBOOK (HVAC Applications).

1.11.1.2 Plant schematic and wiring diagrams shall be the latest revision and shall be framed behind glass and displayed adjacent to switchboards.

1.11.1.3 Operating and Maintenance Manuals shall consist of the following sections:

i. Descriptive Information

This section shall comprise at least the following:

- General Description
- Design Parameters
- Building Load
- Installed Capacities
- Principal Components
- Refrigeration Piping Distribution Schematics
- Air Distribution Schematics
- Electrical Board Schematics
- Control Schematics

ii. Equipment Data Comprising

This section shall comprise at least the following:

- Equipment Designation
- Manufacturer and Model
- Size and Rating

- Pressure Speed and Temperature Limitations
- Manufactures Local Representative.

iii. Operating Instructions

Complete instructions for all equipment including:

- Starting and Stopping Procedures.
- Time Switch Functions.
- Seasonal Adjustments.
- Sequence under Loading and Unloading.
- Normal Operation and Tripped Conditions.
- Logs and Records to be kept.

iv. Inspection and Maintenance

- Inspection Schedules and Checklist.
- Air Filter Maintenance Schedules.
- Routine Replacements, Adjustments and Calibrating.
- Routine Cleaning, Painting and Protection.
- Inspection and Maintenance Logs and Records to be kept.

v. Reference Documents

Reference documents to include:

- Tender Specification & Drawing List
- As built Record Drawings
- Test Reports

- Commissioning Reports

vi. Equipment: Manufacturers Data

This part of the Manual shall consist of manufacturer's data including:

- Descriptive Literature
  - Catalogue Cuts, Brochures or Shop Drawings
  - Dimensioned Drawings
  - Materials of Construction
  - Parts Designations
- Operating Characteristics
  - Performance Tables and Charts
  - Performance Curves
  - Pressure, Temperature, and Speed Limitations
  - Safety Devices
- Operating Instructions
  - Pre-start Checklist
  - Start-up Procedures
  - Inspection during Operation
  - Adjustment and Regulation
  - Testing
  - Detection of Malfunction
  - Precautions

- Inspection Instructions and Procedures
  - Normal and Abnormal Operating Temperature, Pressure and Speed Limits.
  - Schedule and Manner of Operation
  - Detection Signals
- Maintenance Instructions and Procedures
  - Schedule of Routine Maintenance.
  - Procedures.
  - Troubleshooting Chart.
- Parts List
- Service Contracts

1.12 MAINTENANCE

1.12.1.1 Report to an official nominated by the Client on arrival and again on leaving their premises on the occasion of each visit. Such person, who has been nominated by the Client, shall sign a Service Report giving details of corrected temperature and humidity readings taken, etc.

1.13 GUARANTEE

1.13.1.1 The selected subcontractor shall guarantee the materials, apparatus and workmanship delivered and installed by him. The guarantee shall be valid for a period of twelve months starting on the date when the practical completion certificate is issued, the complete installation shall be guaranteed against defects as a result of patent and latent defects of the apparatus, as well as against faulty materials and workmanship. Fair wear and tear is excluded from the guarantee.

1.13.1.2 The guarantee shall provide all parts, spares and appurtenances which become defective during the guarantee period, to be replaced free of charge to the client. All costs of labour, out-of-town town allowances, materials and transportation required to replace such part of a defective installation shall be borne by the selected subcontractor

and shall be included in his guarantee. The selected subcontractor shall cede to the client the remainder of any equipment guarantee which he has received from his suppliers and which may extend beyond the period of twelve months mentioned herein.

1.13.1.3 Where certain equipment have supplier's standard guarantee clauses of which do not correspond with the guarantee clause 22.1 the selected subcontractor shall allow in the tender price for the extensions of guarantees and additional charges thereof, in order to comply with guarantee clause.

1.14 DRAWING SCHEDULE

1.14.1.1 The following drawings accompany this specification, and *Contractors* shall verify that they are in possession of the drawings. Should any of the listed drawings be missing from the Tender Documents, the onus will be on the *Contractor* to notify the Engineer accordingly and obtain such drawings.

Table 3: Drawings Details

Drawing number	Revision	Title
XDN.E.037-1-100-M-LA-0001-01	0A	HVAC LAYOUT - GROUND FLOOR
XDN.E.037-1-100-M-LA-0002-01	0A	HVAC LAYOUT - FIRST FLOOR
XDN.E.037-1-100-M-LA-0003-01	0A	HVAC LAYOUT - SECOND FLOOR
XDN.E.037-1-100-M-LA-0003-02	0A	HVAC ELEVATIONS
XDN.E.037-1-100-M-LA-0004-01	0A	FIRE PROTECTION LAYOUT – GROUND FLOOR
XDN.E.037-1-100-M-LA-0005-01	0A	FIRE PROTECTION LAYOUT – FIRST FLOOR
XDN.E.037-1-100-M-LA-0006-01	0A	FIRE PROTECTION LAYOUT – SECOND FLOOR