



SECTION 6: SPECIFICATIONS

PART 1: GENERAL SPECIFICATIONS

1 GENERAL

- 1.1 The preliminary items included hereunder apply to the whole of the Works contained in Quotation Summary and Schedule of Rates and the rates and/or amounts inserted by the Contractor shall be deemed to apply to the whole of the Works carried out under this Contract including all variations to the Contract.

In the event of a lump sum only being inserted in respect of this Bill, the Contractor will be required to provide an itemized breakdown of the amount so included.

In the event that no amount is inserted by the Contractor in respect of this Bill, no relative payment whatsoever will be included in interim payments.

1.2 Materials and Workmanship

The Contractor shall as directed furnish the Project Consultant with approved documents to prove that the materials are as specified.

All referenced local or foreign standards and/or Codes of Practice shall be of the latest amendments to these standards and/or codes of Practice.

Samples of materials shall be submitted to the Project Consultant for approval before order is placed with the supplier.

1.3 Care of works and Materials

The Contractor shall be responsible for the care of the Works and the safe custody of all materials delivered to site by his specialists, suppliers or sub-contractors, against all risks arising from weather, negligence, damage or loss until the Works are certified complete by the Project Consultant. The Contractor shall also allow for all necessary watching and security lighting.

1.4 Periodic Cleaning Up

All rubbish and debris will be deposited in proper containers & cleared from the site from time to time as they accumulate or when so directed by the Project Consultant. Particular attention is to be directed to those areas where the Employer's staff or other contractors shall be working in.

1.5 Dumping of Debris and Rubbish

The Contractor will dispose of all unwanted debris, rubble or excess earth at approved dumping grounds. All charges levied for use of the dumping grounds shall be borne by the Contractor.

If the Contractor is found to have dumped debris or rubble on any land owned by the Employer or the Government without written permission the Contractor shall be liable for the removal of all the debris, rubble, and other matters found at the dumping sites at his own cost.

1.6 Inspection of the Works Prior to Certified Completion

The Contractor shall conduct detailed checks on the works and rectify all defects before arranging for the Project Consultant to inspect the works for the purpose of certifying completion of the works.



The Contractor shall ensure that all items to be incorporated into the works have been so incorporated before arranging for inspection by the Project Consultant. The Project Consultant may not inspect the Works if any of the above said items are not incorporated into the works. The Contractor shall not be entitled to any claims and to any extension of time on account of such failure to ensure that all items are incorporated into the Works.

After the first inspection by the Project Consultant, the Project Consultant shall give the Contractor a list of outstanding defects and the Contractor shall rectify all defects on the list within seven (7) days therefrom.

If any of the defects in the list is not rectified on the second inspection by the Project Consultant, the Employer may also at its discretion, exercise its right under the Nuisance and Irregularities Clause 4 to impose charge against the Contractor. The Contractor shall be given another seven (7) days to rectify these defects. Should any of these defects be found not rectified on the third inspection, the Employer shall employ and pay another contractor to rectify the defects and all costs and expenses incurred by the Employer shall be recovered from the Contractor. The Contractor may also be debarred from tendering for a specified period.

1.7 Cleaning up on Completion

The Contractor shall remove all rubbish, plant and surplus materials, wash or scrub clean floors, staircases, paving, drains, and all parts of the building and leave the works in a clean and hygienic condition fit for habitation on completion. The site and periphery shall be cleared of all rubbish resulting from the Contractor's work.

1.8 Rectification of Defects After Certification of Completion

The Contractor shall within ten (10) working days from the date of the written notification by the Employer at the Contractor's own cost repair, rectify and make good to the satisfaction of the Employer all defects, imperfections, shrinkages and other faults arising from or out of the use of materials or workmanship not in accordance with any obligation in his part under the contract which may appear, arise or become manifest.

If the Contractor fails to repair, rectify and make good as aforesaid. The Employer may at its discretion exercise, its rights under the Nuisance and Irregularities Clause 4 to impose charges against the Contractor for the defect, imperfection, shrinkage or other fault as aforesaid per day for each day until the same are repaired, rectified and made good all to the satisfaction of the Employer.

Without prejudice to the aforesaid, the Employer shall have the right to engage other person(s) or contractor(s) to repair rectify and make good after ten (10) working days from the date of written notification by the Employer, and the cost of repair, rectification and making good the same plus a 20% charge shall be recovered from the Contractor by deducting the same from any monies due or to become due to the Contractor or recovered as a debt due by the Contractor to the Employer.

The decision of the Employer on the interpretation and implementation of this clause shall be final and binding on and conclusive against the Contractor.

1.9 Research Work

The Contractor shall provide access to the site and render all necessary assistance to the Project Consultant in conducting research work into various aspects of work.

1.10 Foreman

The Contractor shall provide on-site, at all times while the Works is in progress, an efficient and skilled foreman (provided with a pager/mobile phone) who is empowered to receive and carry out any verbal/written instructions from the Project Consultant. He shall be contactable at all



1.11 Programme/Schedule

The Contractor shall submit a work programme/schedule for Project Consultant's approval within two (2) weeks before commencement of the Works.

1.12 Safety & Housekeeping

The Contractor shall maintain and ensure a safe working environment by keeping the site neat and tidy and free from all hazards and debris.

The Contractor will erect proper screens to prevent dust and dirt from entering the offices in and around the Contract Area to the satisfaction of the Project Consultant

The Contractor shall take all safety precautions to eliminate danger to his workmen, the Employer's staff, visitors, the general public and property of the Employer and others.

The Contractor shall erect and maintain proper warning signboards and barriers during the progress of works that may endanger the safety of the staff working there and others. The warning signboards and barriers shall be sufficiently large so as to be clearly visible to draw attention and shall include words such as "Danger", "Keep Out", etc. as appropriate.

2 MATERIAL

2.1 Approval of Samples and Trade Names

Where trade names or catalogue numbers are specified herein, they are intended only to serve as a guide to the respective type and quality of material required. Other material proposed by the Contractor may be used subject to the prior approval of the Project Consultant. In this respect, the Contractor shall submit sample or samples of the proposed material to the Project Consultant for approval.

2.2 Local Products

Where two or more alternative material are proposed by the Contractor under Clause 2.1 (Approval of Samples and Trade Names), the S Project Consultant O may at his sole discretion give preference to the use of material manufactured locally in lieu of imported materials provided that, in the opinion of the Project Consultant, the locally manufactured materials are considered equivalent or better in performance and quality. In case of doubt, the Contractor shall refer to the Employer or the Project Consultant before submitting a Quotation proposal to establish whether such locally manufactured materials are acceptable and permitted for use in the works.

2.3 Storage Facility for Materials

The Contractor shall provide adequate storage facilities at the site to accommodate materials for the Works. The Contractor shall take all necessary precaution to prevent spillage, damage of the Employer properties, and shall make good all areas disturbed.



3. SAFETY

3.1 Site Safety Measures

A high standard of site safety is to be carried out. The Contractor shall ensure that site safety measures are carried out in full compliance with the relevant authorities' regulations, safety circulars by the local authorities and or any by-laws requirements.

The Contractor must conform to and meet all the requirements of the local regulations.

It shall be the duty of the Contractor to comply with all such requirements of the regulations, as may affect him or any person or person employed by him, and as related to any work, act or operation performed or about to be performed by him. The Contractor shall not permit any person to do anything not in accordance with the generally accepted principles of safe and sound practice.

The Contractor shall ensure a safe environment on the site at all times. All safety provisions shall be properly maintained and shall not be removed without the written approval of the Project Consultant. The Contractor shall ensure that necessary and sufficient precautions are taken by his workmen when safety provision is to be used, unless he has satisfied himself that the provision is safe.

The Contractor shall ensure that the requirements of the regulations and the following requirements are strictly complied with at all times.

The Contractor shall conduct the risk assessment and submit a report to Project Consultant at least one week before commencement date of the Contract. No work on site shall proceed prior to the acceptance of the risk assessment by the Project Consultant.

(a) Safety Helmets

The Contractor will provide safety helmets to all workmen on the site and shall ensure that they are properly used at all times.

(b) Safety Belts

The Contractor will provide safety belts, lifelines and all devices for the attachment of lifelines, to all workmen who are required to work in or at areas where they are liable to fall. All safety belts, lifelines and devices for the attachment of lifelines will be of adequate strength. The Contractor will ensure that the safety equipment provided will be used by the workmen.

(c) Warning Signs

The Contractor will erect and maintain proper warning signboards and barriers during the progress of Works that may endanger the safety of the staff working there. The warning signboards and barriers will be sufficiently large to attract attention and shall include words as "Danger", "Keep Out", etc. as appropriate.

(d) Overhead shelters

The Contractor will provide as and when directed by the Project Consultant suitable overhead shelters at places where workmen are required to work or pass which are normally expected to have falling materials or objects.



(e) Scaffolding

The Contractor will provide and maintain all scaffoldings required for the Works. Scaffoldings will be erected in compliance with the relevant safety regulations and removed when needed.

(f) Erection/Dismantling of Scaffolding

- (i) Sufficient number of qualified workmen must be deployed at the site in order to ensure that the operation is expeditious and smooth.
- (ii) Unwanted poles must not be stacked up along the common corridors but must be removed immediately from site.
- (iii) No poles will be thrown down from upper floors.
- (iv) The Contractor and his scaffolding sub-contractor will be present to control the workmen during the erection and dismantling operation.

(g) Personal Protective Equipment

The Contractor shall provide and maintain suitable personal protective equipment to all workmen employed on the Site. The Contractor shall ensure that such personal protective equipment comply with the requirements of the regulations. The Contractor shall also ensure that all equipment are properly used by his workmen during the course of their work. The Contractor shall record the issuance of all equipment to his workmen in the prescribed forms and such forms shall be kept in the Contractor's office and made available for inspection at all times.

3.2 Reporting of Accidents

All accidents on site shall be reported immediately to the Project Consultant. The Contractor shall give notice in writing to the Employer within two (2) days of the occurrence of any accident where the accident results in death or temporary incapacity of any workman employed by him or his sub-contractors. If the Contractor fails to report the occurrence of the accident within the stipulated time, the Employer shall at its absolute discretion exercise its rights under the Nuisance and Irregularities Clause 4 to impose charges against the Contractor.

4 NUISANCE AND IRREGULARITIES

4.1 Charges shall be imposed against the Contractor if the Contractor is found to have committed any of the following irregularities:-

- (a) Omitting building materials or labour, reducing the sizes of the materials, using inferior materials; or materials constructed not according to the Specifications or Drawings;
- (b) Creating nuisance at the Site thereby causing inconvenience to the Project Consultant or the public or committing similar acts (such as not complying with site safety requirements, etc) which are likely to bring the Employer into disrepute;
- (c) Non-compliance with any part of the Specifications or Drawings, or non-fulfilment of any contractual obligation,



4.2 In addition to the above charges, the Project Consultant is empowered

- (a) To order any irregular work to be removed and made good to the satisfaction of the Project Consultant at the Contractor's expense; or
- (b) In lieu of correcting work not done in accordance with the contract, the Project Consultant may allow such work to remain and shall recover any cost differences between the specified requirements and the non-compliance.

For nuisance on site, the Contractor must take immediate action to cease the nuisance committed upon instruction given by the Project Consultant.

5 MEASUREMENT

- 5.1 The dimension shown in the drawings are only indicative. The Contractor shall take site measurements and clarify with the Project Consultant on any discrepancy before commencement of works. The Employer shall not consider any claim for extra cost due to lack of information.

6 WORK DELAYS/ STOPPAGES

- 6.1 During the course of the Works the Contractor may, as and when instructed by the Project Consultant, have to stop works if the Project Consultant deems that such stoppages are necessary to facilitate the Employer's operations.
- 6.2 The Contractor will allow in his Quotation for cost for delays in his works due to the above- mentioned stoppages, partial handing over of site/work areas to him and rescheduling of his works as instructed by the Project Consultant. The Contractor will not be entitled to any claim for extra cost due to such delays.

7 COMPLETION CERTIFICATE AND ACCEPTANCE PROCEDURE

- 7.1 The Contractor shall submit the details of the commissioning specialist whose qualifications must be to the satisfaction of the Project Consultant. The Project Consultant reserves the right to reject any unsuitable person.
- 7.2 The installation shall be 'Practically Completed' following satisfactory commissioning and the submission of the completed final commissioning data and the Contractor will be duly issued a Certificate of Practical Completion. The Defects Liability Period will commence on the date of certified practical completion.
- 7.3 A joint inspection will be held between the Project Consultant and Contractor to establish an outstanding works and defects list. All outstanding works/defects shall be completed within one (1) week from the when the Certificate of Practical Completion was issued
- 7.4 If, at the end of the one (1) week's period from the date of issuing the



Certificate of Practical Completion, any defects/outstanding works mentioned in the list have not been rectified, the Project Consultant is empowered to appoint a body to rectify all defects/outstanding works and deduct the cost involved from the retention money.

- 7.5 One month before the end of the Defects Liability Period, a final defects inspection will be made and the Contractor has one month to clear all final defects.
- 7.6 Upon clearing of all final defects and satisfactory inspection, the Project Consultant will issue the Final Completion Certificate before the release of the retention money.

8. SETTING OUT

The arrangement of the various equipment and associated services shall follow closely that set out on the Drawings except where modification is required to suit the specific materials and equipment to be provided, to fit in with the latest available information on the building construction details, to meet the requirements of other services and equipment or to incorporate improvements proposed by the Contractor, and such other modifications as directed by the Architect.

The Sub-Contractor shall be responsible for the setting out of the equipment and associated services to meet the requirements of the specification.

The setting out and design shall be in accordance with best engineering and trade practice and that of the various equipment and systems shall be such as to allow for proper operation and ease in servicing and maintenance of the installation. All controls and operating devices shall be readily accessible; and indicating and warning devices visible. Where unavoidable, access platforms shall be provided.

All services run (pipes, conduits, ducting, etc.) shall be fixed clear of each other and shall be arranged so far as is reasonably possible to afford easy access for maintenance and repair. No service run shall be installed or fixed behind other services run and shall be readily replaceable along its full length. Where difficulty is experienced in setting out to meet these requirements, the problems shall be brought to the Architect for his decision.

8.1 CLIMATIC CONDITIONS

All equipment and materials supplied and forming part of the works shall be capable of achieving the specified performance under, and be capable of withstanding the following conditions:

Maximum ambient air temperature	- 35°C db
Minimum ambient air temperature	- 21°C db
	(Shade)
Maximum ambient wet bulb	- 30°C wb
Rainfall intensity	- 50mm in 15 minutes
Wind velocity and pressures	- Test results available for review at Project Architect office
Peak solar radiation	- 1,100 W/m ²
	(Horizontal surface)

The Sub-Contractor shall take account of the close proximity of the site to the sea and the presence of salinity within the atmosphere in the design & choice of materials for the works.

8.2 TROPICALISATION, FUNGUS AND RUST PROOFING

All equipment shall be protected against the formation of fungus and rust from the time it is



delivered to the time it is put into operation. Fungus & rust proofing shall be accomplished in a recognised & approved manner which could be by means of protective varnishes manufactured specially for the purpose & applied at the factory prior to the delivery, whichever method is adapted. The system will have total protective qualities. All equipment supplied shall be tropicalized & suitable for the most onerous condition to be encountered.

8.3 MATERIAL AND WORKMANSHIP

All materials and equipment supplied for this Sub-Contract shall be new and un-used. All such materials and equipment shall be of the best type for each particular purpose and of the best quality as regards design, manufacture and performance. All works shall be carried out in accordance with best engineering practice by fully competent tradesmen of appropriate grades.

8.4 WELDING AND CUTTING

All welding work undertaken as part of the works shall be carried out by welders who have, within six months of the performance of the welding work, undertaken a welding test and obtained a welding certificate from a testing agency acceptable to the Architect.

Where more than one welder is engaged in the works then each weld shall be capable of being identified as the work of an individual welder.

Under no circumstances shall the welding or flame cutting of galvanised steel be permitted.

No welding or flame cutting shall be undertaken without the prior authorization of the Sub-Contractor and unless satisfactory fire protection and safety measures are in force.

8.5 GALVANISING AND STAINLESS STEEL

Unless otherwise stated all references to galvanising shall be hot dipped galvanization in accordance with BS EN ISO 1461.

All references to stainless steel shall be 316 Grade Stainless Steel.

8.6 PROTECTION

The Sub-Contractor shall be responsible for the protection of all equipment and materials both in storage and installed on site. Damaged or deteriorated equipment and materials shall not be permitted to be used as part of the installation it being the responsibility of the Sub-Contractor to remove from site and replace such items at no additional cost to the owner.

The Sub-Contractor shall ensure that all necessary measures are taken to avoid damaging other construction and installation works during the course of their installation, testing commissioning or operation of the systems forming part of the works. The cost of repairing or replacing any damage caused to other works shall be the Sub-Contractor's responsibility.

8.7 STANDARDISATION

Materials, equipment and fittings shall be standardised as far as possible throughout the installation. In particular, every attempt shall be made to achieve standardisation in the following respects:

- All major units of equipment shall be supplied by a single manufacturer and other equipment shall be supplied by the smallest possible number of manufacturers.
- All electric motors shall be of the same make and have the maximum interchangeability of components.



- All items which are of a similar nature shall be obtained in each case from a single manufacturer or from the smallest possible number of manufacturers.
- All items for similar duties shall be the same make and model.

8.8 EQUIPMENT

Each item of equipment shall generally be a standard proprietary design manufactured in quantity by an established manufacturer of such equipment and shall incorporate all the features customarily accepted as being essential to equipment of its type and for the service intended where such features are not inconsistent with the provisions of this Specification.

8.9 ELECTRICAL

The Sub-Contractor shall provide electricity supply to all Mechanical equipment. All cables are to be terminated in isolators or control panel with control panel to be provided by others.

8.10 METRIC UNITS

The Sub-Contractor shall provide all information, manufacturer's data and materials in metric (SI) units and dimensions.

8.11 SHOP DRAWINGS

The Sub-Contractor shall, at times specified and well before the relevant work proceeds, prepare and submit for review, detailed, fully co-ordinated shop drawings based on the Sub-Contract Drawings, taking into account any modification either to the works or to the installation which may have taken place and correctly related to the details of the actual items of plant and equipment to be installed.

The required sets of shop drawings shall be submitted to the Architect and shall be constantly updated to reflect modifications and changes agreed/accepted by the Architect and to reflect design changes issued by Architect's instructions.

The Sub-Contractor shall similarly prepare all necessary schedules of equipment, etc., and also all necessary wiring diagrams for items of electrical equipment and diagrams showing the interconnections between different items.

To assist the Sub-Contractor in the preparation of his shop drawings, one set of Sub-Contract Drawings shall be provided after the award of the Sub-Contract. The Sub-Contractor shall be fully responsible for updating his shop drawings based on any changes to the Sub-Contract Drawings which may from time to time be required.

Shop drawings (i.e. installation drawings) for each system shall be provided as specified, on the same scales as for the as-built drawings.

Shop drawings shall be submitted within two months of the award of the Sub-Contract or less than twelve months prior to the commencement of the Sub-Contract Works on Site, whichever is the sooner.

In particular before beginning fabrication of the equipment, the submission of scaled shop drawings shall be required of all work and equipment showing the equipment working positions, the general arrangement of all plant and tank rooms, electrical equipment and electrical installations.

All shop drawing shall be submitted through the Main Contractors and shall contain the Sub-Contractor's endorsement thereon as required by the Main Contract Documents.

Shop drawings shall be prepared in the following metric scales:



Floor plans & section	1: 50
Plantroom layout, sections & elevations	1: 20
Details	1: 20 or 1: 1

The Sub-Contractor shall produce elevation drawings of all services recessed in walls and / or floors where these services are embedded within apartment unit walls. These drawings shall also include dimensions of these cable route and or pipe routes against prominent references / gridlines.

8.12 BUILDER'S WORK DRAWING

The Sub-Contractor shall review and subsequently distribute builder's work drawings and schedules showing details of builder's work required in connection with the installation of the Works.

In cases where preliminary builder's work information has already been given on the Sub-Contract Drawings, such information is to be checked by the Sub-Contractor and incorporated in his own builder's work drawings.

It is the intention that all holes chases, etc. shall be left in the structural building work as it proceeds and not cut out subsequently, except in so far as may be necessary due to subsequent authorised variations to the Sub-Contract Works.

The Sub-Contractor shall acquaint himself throughout the period of the Works, with the Sub-Contractor's detailed construction programme, and shall prepare the builder's work drawings in such order and at such times as to enable them to be reviewed and subsequently issued.

No claims will be entertained in respect of additional holes, chases, etc., required after the structure has been constructed unless these are necessary due to authorised variations to the Works.

8.13 "AS-NEW" CONDITION

At the time of handover of the Sub-Contract Works prior to the issue of the completion certificate, the whole installation shall be in "as-new" condition. The Sub-Contractor shall, in accordance with the Contractor's conditions during the course of the Contract, protect all plant and equipment, and shall restore/repaint as necessary before completion of the Contract.

8.14 AS-BUILT DRAWINGS

Before the Date of Completion of the Contract, the Sub-Contractor shall provide As-built drawings as specified for all equipment and systems for the complete installation, incorporating all amendments made during the course of the Sub-Contract.

During the preparation of working drawings, the Sub-Contractor shall liaise closely with other Contractors and Sub-Contractors to ensure complete co-ordination of services installed by all parties.

As-built drawings shall be developed by competent draughtsmen throughout the installation programme and shall form a continuously updated record of the Sub-Contract Works installed.

The Sub-Contractor shall produce elevation drawings of all services recessed in walls where these services are embedded within apartment unit walls. These drawings shall also include dimensions of these cables / pipe routes against prominent references / gridlines.

Four (4) bound sets of all As-built drawings together with three (3) sets of computer softcopy



in CD of each drawing in the latest AutoCad format, shall be submitted to the Architect prior to the date of issue of the Certificate of Completion.

As-fitted schematic system diagrams, properly framed, shall also be provided and mounted on the wall inside each plant room.

In addition, the Sub-Contractor shall obtain and provide the requisite number of sets of Manufacturer's Operation, Maintenance Manuals and detailed working drawings of all plant, equipment, pumps appliances, systems, refrigeration, motors, switch gears, internal wiring diagrams, etc., as may be appropriate and with suitable titles and reference numbers added on.

The exact scope and details of all Instructions and Record Drawings shall be agreed with the Architect. All operating Instructions and Record Drawings are subjected to the written confirmation of the Architect.

The Sub-Contractor shall note that retention monies will not be released after the satisfactory completion of the Period of maintenance until the "As-built Drawings" together with the operation and maintenance manuals have been submitted and approved by the Architect. The Sub-Contractor shall fully comply with all requirements of the Specification in this respect.

8.15 AS-BUILT DRAWINGS FOR AUTHORITIES' EXAMINATION AND CERTIFICATION

The Sub-Contractor shall prepare the required sets of As-Built Drawings and certify on these drawings that the drawings reflect the actual works installed. These drawings shall be submitted to the Authorities, through the Architect, for examination by the Authorities or by Registered Inspectors.

The Sub-Contractor shall ensure that the As-Built Drawings to be submitted for examination and certification by the Authorities shall conform in layout to the latest Architectural Plans.

The As-Built Drawings shall be submitted to the Architect for checking before submission.

The Sub-Contractor shall ensure that this submission of As-Built Drawings will not delay subsequent Authorities' inspections and tests, otherwise the Sub-Contractor shall be fully responsible for any consequence due to his delay. These drawings shall be submitted at least two months before scheduled Authorities/RI inspection.

8.16 SAMPLES

The Sub-Contractor shall on request or where specified elsewhere submit to the Architect through the Sub-Contractor, samples of materials and/or workmanship and such samples shall be reviewed and commented on in writing before the appropriate equipment or installation work is carried out.

Such samples are subsequently to be retained by the Architect as the criteria of the standard of the workmanship or material to be supplied and any items not so complying may forthwith be rejected by the Architect and shall be replaced by the Sub-Contractor without increase to the Sub-Contract Sum.

8.17 LOADING CALCULATION

The Sub-Contractor shall submit loading calculations including any and all loads imposed on the building structure. The calculations shall be prepared and certified by a Registered Professional Engineer.

8.18 SUBMISSIONS

All submissions by the Sub-Contractor shall be full and complete in all details and shall be



checked and verified prior to his submission of the material to the Architect for review.

No claims for extensions of time or additional costs shall be entertained as a result of the Sub-Contractor's failure to make his submissions in adequate time in a satisfactory manner.

8.19 GUARANTEE

The Sub-Contractor in providing a specific piece of equipment or apparatus, whether specified herein by name or whether of a make selected by the Sub-Contractor, shall be deemed to warrant its satisfactory performance under all working conditions which may be encountered.

Unless otherwise stated in this Specification, the Sub-Contractor's guarantee for the Sub-Contract Works shall extend for the entire Maintenance Period from the Date of issuance of the Certificate of Completion of the Sub-Contract Works. The guarantee, in an agreed form, shall be vested in the name of the Employer.

In the event that any manufacturers' guarantees are still within their term of validity at the Date of Completion for the Works, then all such manufacturers' guarantees shall automatically be assigned to the Employer. All subsequent rights and liabilities under the manufacturers' guarantees shall be the Employer's.

In the event of anything described in the specification or shown in the Sub-Contract Drawings, being, in the Sub-Contractor's opinion, unsuitable or inconsistent with his guarantee or responsibilities, the Sub-Contract shall draw attention thereto at the time of tendering.

Neither the time limit imposed on the Sub-Contractor's guarantee, nor the final completion Certificate issued by the Architect, nor the acceptance of the installation by the Employer, nor the checking for compliance with the design intent of any material or method shall in any way absolve the Sub-Contractor from his responsibility for any latent defects in the Contract Works which may become apparent in the future and which are, in the opinion of the Architect, due to the Sub-Contractor's failure to use materials and methods which comply to this Specification and the Sub-Contract Drawings.

8.20 OPERATION AND MAINTENANCE MANUALS

The Sub-Contractor shall, prepare the complete Maintenance and Operating Instructions which are to be printed in English for the installation. When these instructions have been agreed in detail with the Architect, the Sub-Contractor shall submit to the Architect, four (4) copies thereof suitably bound. The Operating Instructions must be handed over before the Date for Completion of the Contract.

The Sub-Contractor shall allow for operating all plant on behalf of the Employer up to the date of issuance of the Completion Certificate.

The Sub-Contractor shall have allowed in his tender for providing the services of a sufficient number of English speaking skilled men to cover each trade engaged on the building services installation for the purpose of instructing the Employer's staff, for 6 months after the issue of Completion Certificate.

Before Completion of the Works, about 2 months before commencement of the Maintenance Period, four sets of maintenance and operating manuals are to be provided by the Sub-Contractor, bound in suitable hard covers, properly labelled and identified; they shall contain the following (Properly ordered and indexed) in a form completed and to submit and approved by the Architect.

a) Index

Comprehensively list all elements and sub-elements of the subject matter.



b) Description of all systems and equipment

Shall comprehensively describe

- Introduction and general description
- Scope of work executed
- Description of each system, including function and composition

c) Method of Operation of all system

Shall comprehensively describe

- The correct method of operating all manually controlled items of plant for all specified modes of operation, including start-up, shutdown and emergency procedures.
- The operation of all automatic control systems.

d) Method of Maintenance and overhauling all Equipment

Shall comprehensively describe all procedures necessary to undertake the operational, cyclic and breakdown maintenance of all items of plant. Such instructions shall include exploded diagrams of the components of each plant items. Manufacturer's recommendation of frequency and method of overhauling shall be included.

e) Equipment Schedules

Shall comprehensively list details of all items of equipment installed and the equipment suppliers and/or agents, such details shall include the original purchase orders and/or invoices numbers of each item of plant, having a manufacturer's warranty period extending beyond the expiry of this Contract's Liability Period.

f) Manufacturer's Literature and Performance Data on all equipment

Original copies of all technical literature shall be supplied with performance data/curves (e.g. pressure against flow rates, etc. for pumps) and each shall have appropriate operating point indicated thereon.

g) List of Spares

Shall comprehensively list any spare parts to be provided under the Contract and any special tools to be provided, together with a description of their use.

h) Commissioning and Capacity Test Result

Shall include the following information, such information having been accepted by the Architect:

- Commissioning and capacity test result
- Factory test result
- Air and water balancing results
- Calculations verifying achievement of specified performance requirements



- Schedules of control set points and balancing settings.

Where capacity tests have not been undertaken at the time of Completion, provision shall be allowed in the manual to include these results after the tests have been carried out.

i) List of As-Built Drawings

Shall contain a full list of all "As-Built" Drawings.

8.21 DUTIES AND SIZES OF PLANT AND EQUIPMENT

The duties of plant and equipment described in the Sub-Contract are minimum duties and Sub-Contractor shall confirm them with the Architect taking into account any variations which may be made to the systems during the progress of the Sub-Contract Works.

The Sub-Contractor shall be required to demonstrate at site that the duties required of the equipment are obtainable.

Physical sizes of all plant and equipment are to be suitable for the spaces allocated for the accommodation of such plant and equipment, taking into account the requirement of access for maintenance purposes.

Before ordering equipment, the Sub-Contractor shall provide the Architect with full details of the weights of equipment for purposes of determining floor loadings, etc.

8.22 MAINTENANCE PERIOD

The Sub-Contractor shall provide, without charge, labour and materials to properly maintain and operate all the Works included under the Sub-Contract for a period specified under the Main Contract after the issue of the Certificate of Completion of the Works as a whole. The Sub-Contractor shall provide competent technicians to take responsibility for maintaining the Works. Foremen, electricians, labourers shall be put at the disposal of the Principal for use during maintenance and repair.

Should the Employer feel that the staffs on the site are too few to carry out specific works, then the Sub-Contractor shall despatch to site immediately the staff so instructed by the Employer.

Such work shall include, but not limited to the following, to satisfy this requirement of the Sub-Contract:-

- a) Repair or replace switchgear, fuse, cable, electronic components, etc. as necessary, including the provision of all equipment.
- b) Provide and replace all malfunction or burnt out panel lamps, and control gear assuming normal office hours in office area, all computer centre related areas to be working 24 hours a day every day of the year.
- c) Repair of water leak & malfunction of water services.

Inspect conditions of equipment operating in site on a daily basis, or as otherwise directed.

- d) Shutdown inspect, clean and test all services at least twice during the period, once at the end of six months and the second time, close to the end of the twelve months period. Any parts required to be replaced during these inspections, and during any other period of the Maintenance Period are to be met at the Sub-Contractor's expense.
- e) Prepare a daily log of all maintenance repairs, replacements, inspections carried out,



including a status report of all equipment. The daily log shall be kept up-to-date and located in such a place that the Employer can inspect it at any time.

- f) The Sub-Contractor shall provide labour and materials to properly maintain and rectify all the works both within normal working hours and outside working hours included under this Sub-Contract for the Period commencing after the date of completion of the Whole of the Contract Works.
- g) Upon instruction by the Employer, whether face to face, or over telecommunication devices etc., in case of fire or when there are operation defects discovered in any of the systems, the Sub-Contractor shall provide qualified engineers and technicians on 24-hour-on-call basis to take responsibility for the maintenance/rectification and operation of the fire services installation works. This 24 hour on call service shall include weekends and Public Holidays.

The Sub-Contractor shall at time of tender provide information as may be required in respect of the proposed staffing levels and grades for the maintenance work.

Up to and including the date of Completion the Sub-Contractor shall be responsible for both maintaining and operating the building services installation.

During the maintenance period the Sub-Contractor shall provide as a minimum the staff levels and equipment and materials including consumable necessary to maintain, operate, repair and overhaul the plant on a routine basis. The materials provided shall be in addition to the spares provided as specified elsewhere within this document.

During the maintenance Period provide a call out service which shall: -

- a) Be available and able to be contacted by telephone 24 hours per day, 7 days a week; and
- b) Attend to call out service within 2 hours
- c) immediately investigate on site the cause of equipment failures, breakdowns, an alarm, false alarm or fault from the installation when informed of such an occurrence; notify the Employer in writing on the circumstances surrounding each call out on the first working day after the call out.

At the end of the Maintenance Period, carry out tests as per Acceptance Tests.

8.23 STATUTORY OBLIGATIONS AND OTHER REGULATIONS

The Sub-Contract Works shall fully comply with all statutory obligations and regulations together with any amendments made thereof as required by the local statutory bodies.

The Sub-Contractor shall arrange for all submissions and pay the cost of statutory inspections and certificates.

The M&E Services Installations shall comply with the local statutory obligations and regulations.

All equipment and installations shall comply with the latest Acts, Regulations, Codes and requirements of relevant Authorities currently in force. British / IEC Standards shall also be adopted if the local standards do not exist.

In case of conflict between the supply authority and the specification requirements, the supply authority shall apply.

8.24 REJECTION OF UNSUITABLE MATERIALS



The Architect shall be at liberty to reject any plant, materials and workmanship not complying with the requirements of this specification or which are in any way unsuitable and to order their removal and replacement, without increase to the Sub-Contract Sum.

The Architect's decision as to what constitutes compliance with requirements and suitability shall be final and binding; the true intent and meaning of the Sub-Contract being that the whole of the Sub-Contract Works shall be completed to the satisfaction of the Architect.

No rejected item shall be considered as a reason for failure to meet the completion date.

8.25 CONTRACTOR'S PROGRAMME

The Sub-Contractor shall conform to the construction programme and shall include everything necessary to complete the Works in a sequential and acceptable manner.

8.26 SILENCE OF OPERATION

The Sub-Contract works as installed shall be reasonably silent in operation having regard to the conditions under and locations in which they will be called upon to operate.

The Sub-Contract shall take all necessary steps to ensure that the equipment supplied by him is silent as specified and shall include for such sound absorbing, or anti-vibration, material or devices as are necessary to ensure a satisfactory degree of silence and absence of vibration in the structure of the Works.

The Architect's decision as to what constitutes satisfaction in this respect shall be final.

If on completion the system is not, in the Architect's opinion, sufficiently silent, the Sub-Contractor shall, without additional charge, carry out such modifications or additions as may be required, until the system is made silent to the Architect's satisfaction.

8.27 LIMITED ACCESS

The Sub-Contractor shall note the limited access available on site for storage of materials and installation work and of the need to arrange suitable off-site storage, if required and at the Sub-Contractor's expense.

All materials and equipment are to be installed in the correct sequence to ensure that all services may be accommodated. Where works by other trades are to occupy the same pipe, duct or plant space the Sub-Contractor shall take care to leave clear access for sequential on future provision of these services within shafts, plant rooms and voids.

8.28 INSPECTION OF CONDITIONS

The Sub-Contractor shall examine related work and surfaces before starting their work and report to the Architect, in writing, conditions which prevent the proper execution of their work.

Starting the work of this Sub-Contract without reporting unsuitable conditions to the Sub-Contractor and the Architect constitutes acceptance of conditions by the Sub-Contractor.

Any required removal, repair or replacement of defective work caused by existing conditions and not reported shall be done at no additional cost to the employer.

8.29 VERMIN PROOFING AND CLEANING

On completion of the Sub-Contract Works, the Sub-Contractor shall check and ensure that all cable entries, pipe entries, openings, core holes, etc. are properly sealed with fire rated



material and rendered vermin proof and water tight. The floors, trenches and surroundings shall be cleaned, mopped, and left in a clean, dust-free state on completion. Building works and paint work of equipment damaged during the installation works shall be made good to the satisfaction of the Architect.

All costs involved in the above shall be deemed to be included in the Sub-Contract.

8.30 POWER SYSTEM HARMONICS

For the purpose of this provision, "PCC" means the point of common coupling being the terminals of the mechanical equipment power interfacing units at the point where they connect to the electrical distribution system. The installation is designed with the intent of complying with current international and European Community electrical immunity and emission standards. In order to continue an interference free service to others' installation, the Sub-Contract must comply with each of the following:

- 1) The sub-contract shall provide adequate measures including active harmonic filters to limit the total harmonic distortion at the PCC to 5% for voltage and less than 12% for current for all phases, in accordance with the requirements of the Institution of Electrical and Electronic Engineers Standard IEEE 519. The Sub-Contractor shall take particular care in the selection of equipment that may produce harmonics including without limitation electronic ballasts, UPS, soft starters and variable speed drives, to ensure that these limits are met at all times.
- 2) The Sub-Contractor shall ensure that the power factor at the PCC is equal to or better than 0.85 lagging.
- 3) The Sub-Contractor shall complete the installation to meet all current international and European Community emission standards for electrical interference for light commercial buildings, including without limitation EN50082, IEC1547, CISPR11, CISPR15, CISPR16, EN55015, EN55011, EN50081, EN60555, EN61000, IEC801, IEC1000 and EN61800.

8.31 ELECTROMAGNETIC COMPATIBILITY (EMC)

The Sub-contractor shall be responsible for ensuring that all equipment supplied conforms to the requirements of relevant international standards in terms of their electromagnetic compatibility with the environment and with all equipment to be installed in the Project. All equipment used shall comply with the prevailing generic EMC requirements and EMC requirements applicable to general, scientific and industrial equipment specified but not limited to the following standards, or their equivalents:

IEC	–	International Electrotechnical Commission standards
CISPR	–	International Special Committee on Radio Interference Document
EN	–	European Standard
BSI	–	British Standard Institution
VDE	–	Verband Deutscher Electrotechniker

All signal and control cabling installed shall be correctly screened and earth to prevent noise and electric shock. Operation of all equipment shall not be adversely affected by radiated energy from hand held communication equipment.

All equipment that is likely to be touched by personnel and contains sensitive electronic equipment shall be protected against electrostatic discharge.

The Sub-contractor shall ensure that any static or alternating magnetic fields, generated in the environment, do not adversely affect the operation of the equipment.

Bonding shall be provided for all exposed metallic parts of the equipment and connecting



them to the earthing network for meeting safety requirements and minimize noise voltage due to potential differences.

Equipment shall be designed so as to minimize radio interference in the frequency range 0.15 MHz to 30 MHz by means of suppression at source.

All equipment supplies, prefabricated and installed shall be designed, manufactured and installed to fully comply with the European Electromagnetic Compatibility Directive 2004/108/EC, Low-voltage Directive 2006/95/EC and Machinery Directive 2006/42/EC.

All equipment supplied to the site shall be either electromagnetically benign or carry the "CE" mark and be provided with copies of the relevant test certificates.

The Sub-Contractor shall ensure that the entire installation shall not be a source of radio interference and whenever necessary suppression devices shall be installed.

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The Sub-Contractor shall ensure that the entire installation shall not be a source of radio interference and whenever necessary suppression devices shall be installed

8.32 MOTOR CONTROL PANEL AT EXPOSED LOCATIONS

For all motor control panels outside plant rooms and at exposed locations such as car park, services area, public space, etc. shall be provided with a lockable front door with viewing glass panel.

8.33 INTERFACING WITH THE OTHER SERVICES AND SYSTEMS

8.33.1 General

The Sub-contractor shall provide all necessary provisions for interfacing with other trades, services, and equipment not under this Sub-contract. All necessary sensors, current/voltage transformers, voltage-free contacts, relays, auxiliary contacts, terminals, transducers, etc. for interfacing with other works shall be provided by the Sub-contractor.

All control/monitoring wiring from sensors, equipment, and components for the interfacing shall be terminated at a separate interfacing compartment located at the respective equipment/system's switchboard or control panel provided under the Sub-contract. The interfacing compartment shall be completed with all necessary connectors, terminals, and with proper identifications to allow interfacing works to be easily carried out. The compartment shall clearly indicate "Extra Low Voltage Cable Only. No Power Cable Connection". Where there is no equipment/system switchboard or control panel involved, the Sub-contractor shall provide separate interfacing panels with provisions same as the interfacing compartment as described above. The locations of the switchboard/control panels and the interfacing panels shall be co-ordinated with the Main Contractor and other sub-contractors.

For every control panel and each module of the switchboard, at least five (5) spare terminals shall be provided for future interfacing works.



Wiring and cables for interfacing with the Fire Alarm System and other fire protection and life safety systems shall be fire rated to comply with Fire Authority's requirements.

Unless otherwise specified or shown on the Drawings, interfacing wiring from Fire Alarm and Building Management/Automation systems shall be provided and terminated at the terminals of the interfacing compartments or panels by the Fire Alarm System and Building Management/Automation System sub-contractor respectively. The Sub-contractor shall co-ordinate with the Fire Alarm System and Building Management/Automation System sub-contractor on the current and voltage requirements for the interfacing works/provisions. The type of provisions for interfacing signals shall be as follows, unless otherwise specified:

- Digital inputs and outputs : voltage-free dry contact
- Analog inputs and outputs : 4 – 20 mA or 0 – 10 mV

All the interface provisions shall be DC operated and rated not more than 50 mA.

For interfacing works between Fire Alarm System and Building Management/Automation System, the Fire alarm System sub-contractor shall provide interface wiring and terminate them at the Building Management/Automation System's interfacing compartments or panels.

The Sub-contractor shall provide and make all power cable connections from their equipment, local control panels, and switchboards to the electrical isolators or power points (including cable termination) provided by the Electrical sub-contractor. Location of power supply isolators and power points shall be co-ordinated and agreed between the Sub-contractor and the Electrical sub-contractor.

In addition to the interfacing requirements shown on the Drawings, interfacing provisions as described below shall also be made by each respective sub-contractor.

8.33.2 Electrical Sub-Contractor

The Electrical sub-contractor shall provide the following for other trades and all other equipment as specified in the Tender Documents:

- 1) Isolators and power points (fused spur units) for equipment and systems of other sub-contractors as shown on the Drawings. The other sub-contractors shall be responsible for connection and extending the power supply to their equipment and control panels. Where shown on the Drawings, the Electrical sub-contractor shall make direct power cable connections to the mechanical system's main motor control centres.
- 2) Earthing terminal in the Fire Command Centre and all other plantrooms for supplementary equipotential bonding of other equipment and systems.
- 3) Power failure signal to the Lift System (including wiring terminations into the Lift interfacing panel in the Lift Motor Room), Fire Alarm System and the Building Management/Automation System.
- 4) Electrical bonding of all roof equipment and external metal cladding including provisions and connection of bonding cables.
- 5) Fuel main storage tank and day tank High/Low level alarm signals to the Building Management/Automation System.



- 6) Emergency power supplies to Building Management/Automation System (including all field panels), Fire Alarm System, carparking system, and all security systems.
- 7) Emergency power supplies to all fire shutters, smoke shutters/curtains, and automatic doors.
- 8) Power points in each toilet for the plumbing trade (for connection to automatic sanitary sensors and flush valve by the Plumbing and Sanitary Sub-contractor).

Power supply to variable air volume (VAV) boxes and the ACMV system's control components/sensors shall however be provided by the ACMV Sub-contractor from the corresponding equipment motor control panel.

8.33.3 Plumbing and Sanitary Sub-contractor

The Plumbing and Sanitary sub-contractor shall provide the following for other trades:

- 1) Water supply connections to water tanks under other sub-contracts including isolation valve.
- 2) Drainage facilities for pressure relief/parity valves and condensate drain from air-handling units and fan coil units. Insulation of drainage pipe receiving condensate drain shall also be provided by the Plumbing and Sanitary sub-contractor.
- 3) Gas leakage signals to the Fire Alarm System, Building Management/Automation System, and the kitchen ventilation fan's motor control panel (including wiring and termination into the fan motor control panel).
- 4) High / Low level alarm signals to the Building Management / Automation System for all water tanks.

8.33.4 ACMV Sub-contractor

The ACMV sub-contractor shall provide the following for the other trades:

- 1) Smoke signal from the air-handling unit return air smoke detector to the Fire
- 2) Alarm System.
- 3) On/Off control and status indications at the Fire Command Centre's Ventilation Panel (to be provided by the ACMV sub-contractor) including switches and indication lights for the following equipment and systems:
 - Entire smoke extraction system including individual fans (and associated motorized dampers), smoke shutters/curtains, smoke damper, etc.
 - Staircase pressurization fans
 - Smoke Lobby ventilation fans
 - Basement carpark ventilation fans



- All automatic fire/smoke dampers
 - Other emergency fans for fire and life safety operations
- 4) High level interface between the chiller control panels and the Building Management/Automation system.
 - 5) Shut down control of air-handling units by the Fire Alarm System on floor-by-floor basis.
 - 6) High/Low level signals to the Building Management/Automation System for all water tanks including feed and expansion tanks.

8.33.5 Fire Alarm System Sub-contractor

The Fire Alarm System Sub-contractor shall provide the following for the other trades:

- 1) All control and monitoring modules for interfacing with all other trades.
- 2) Control signals and modules for all fire shutters, smoke shutters/curtains, automatic doors and all emergency ventilation systems.
- 3) High level interface with the Building Management/Automation system
- 4) Signal to the Lift Motor Room for lift homing operation.
- 5) Signal to all electronic security systems.
- 6) Signal to shut down air-handling units on floor-by-floor basis and all gas supply systems.

8.34.6 Building Management/Automation System (BMS) Sub-contractor

The BMS sub-contractor shall provide the following for the other trades:

- 1 All control and monitoring modules for interfacing with other trades (with the exception of those for interfacing with the Fire Alarm System).
- 2 High level interface with the Fire Alarm System and the chiller control panels.

8.35 STRUCTURAL EXPANSION JOINTS AND SETTLEMENT JOINTS

The Sub-Contractor shall make adequate provisions of flexible joints/connectors and/or expansion loops where services pass through structural expansion joints. The locations of these expansion joints are shown on the architectural/structural drawings. The provisions of flexible joints/connections shall take into account the movement allowance. Detailed calculations shall be submitted by the Sub-Contractor to justify the selection of these flexible joints/connectors.

For settlement joints shown on the structural drawings or required by the Main Contractor for the construction of structural works, the Sub-Contractor shall co-ordinate with the Main Contractor such that any installation which passes through settlement joints shall be executed after the respective settlement joints are cast and the expected structural differential settlement has significantly taken place.



The Sub-Contractor shall co-ordinate with the Main Contractor to ensure that all services installed under metal roof and skylight shall have adequate provisions to take into account the movement and deflection of the roof structure and the cladding.

8.36 TESTING AND COMMISSIONING

All plant, materials and systems shall be tested, and commissioned as specified in the "Commissioning and Testing" Section of this specification.

All testing, and commissioning procedures and documentation shall be reviewed by the Architect prior to commencement. One set of all documents shall be provided for record purposes within each copy of the operating and maintenance manuals.

Prior to commencing the testing and commissioning of the works the Sub-Contractor shall submit to the Architect for review five (5) sets of a report containing documentation and procedures forming part of the testing and commissioning

On completion seven sets of the record documents shall be submitted to the Architect, through the Sub-Contractor for review. Once agreed to by the Architect one set of record documents shall be incorporated into each set of Operating and Maintenance Manuals.

8.37 SUPERVISION

A Licensed Electrical Worker shall be employed by the Sub-Contractor to supervise the entire electrical installation work.

A Licensed Plumber shall be employed by the Sub-Contractor to supervise and submit plans/obtain approvals for the water supply works consociated with the water supply installation.

A Licensed Gas Service Worker shall be employed by the Sub-Contractor to supervise, submit plans and obtain approval for the gas pipe installation works.

**8.38 ATTENDANCE DURING AUTHORITIES INSPECTIONS**

The Sub-Contractor is required to attend to all inspections carried out by Registered Inspectors and Authorities for the purpose of applications of Temporary Fire Permit (TFP), Temporary Occupancy Permit (TOP), Fire Safety Certificate (FSC) and Certificate of Statutory Completion (CSC).

The Sub-Contractor is to provide manpower and equipment, tools and instruments for testing and inspections by the above departments.