

KJ TAIT

ENGINEERS

MRC LABORATORY OF MOLECULAR BIOLOGY

NEW IT ROOM 1S001

CAMBRIDGE

SPECIFICATION – VOLUME 5

**ENGINEERING SERVICES WORK PACKAGE PRELIMINARIES/
GENERAL REQUIREMENTS**

REVISION P03

TENDER ISSUE

Document History

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1.0 DEFINITIONS

Throughout this document the following definitions shall apply:

Main Contractor shall mean the Contractor appointed by the Employer to carry out the construction of the works.

Sub-contractor shall mean the Services Work Package Contractor appointed by the Main Contractor.

Specialist Sub-contractor shall mean a Sub-contractor employed and supervised by the Services Work Package Contractor.

2.0 TENDERING/SUB-LETTING/SUPPLY

2.1 General

The amount of the submitted tender should have due regard and is therefore deemed to make due allowance for:

- Compliance with the Conditions of Contract insofar as they apply to these Sub-Contract Works
- All the requirements, responsibilities and restrictions that will be placed upon the Sub-contractor by this Tender Enquiry Document if the tender is accepted
- Designing, producing drawings and all other information, manufacturing, installing and where appropriate, setting to work the whole of the Sub-Contract Works in accordance with the Technical Specification and drawings forming part of the tender document including all labour, materials and plant whether temporary or otherwise.

The Sub-contractor will be deemed to have visited the site before tendering and ascertained all local conditions and restrictions likely to affect the execution of the Works.

The Sub-contractor shall satisfy himself as to the nature, extent and character of the Sub-Contract Works and the whole Works of which they form a part.

The Sub-Contract Works will be carried out concurrently with others working on the site and the Sub-contractor should allow for any effect this may have on their method of working, price and programme in assessing their tender.

The tender shall include for all the works and items specified in the tender documents and indicated on the drawings, and all costs associated with procuring and completing the same and for any item which the Sub-contractor would normally install or provide in order to complete the Sub-Contract Works concerned which may not be specifically referred to or shown.

It may be that to enable the Sub-Contract Works to function and/or to be undertaken certain works (eg. builders work) will need to be carried out by others and in certain cases this will be dependent on the provision by the Sub-contractor of relevant information, details and drawings.

It is the Sub-contractor's responsibility to highlight those items of work they has excluded, otherwise the above clause will apply, and in due time provide the necessary builder's work drawings so that others can be instructed to undertake the work.

Sub-contractors will be deemed to have included for all costs and requisite number of site visits and any necessary overtime, both on site or off site including that in drawing offices, fabrication shops, etc, bonus or incentive payments to carry out and complete the Sub-Contract Works in accordance with the agreed programme and within the overall limits of the Main Contract programme.

Where necessary Tenderers are to supply sufficient calculations, details and drawings with their tender to indicate their detailed proposals and to enable their suitability to be assessed.

No payment will be made for Tenders.

The Employer does not bind himself to accept the lowest of any Tender.

2.2 Tender for the Complete Installation

The Works covered by this Tender are the design development, production of working drawings, fabrication, works testing, supplying and delivering to site, erecting, connect up, testing, commissioning, performance testing and handing over in working order the complete installations described in the Tender Documents.

The Tender shall be for complete installations and not only the major items of plant and equipment contained within the Tender Documentation but also all incidental sundry components necessary for the complete execution of the work. The Tender shall include the proper commissioning, performance testing and operation of the Sub-contractor installation and notwithstanding the obligation of the Sub-contractor to produce co-ordination and installation drawings and the like based on the Sub-Contract Drawings, no additional cost will be allowed for want of knowledge in this respect.

The Sub-contractor shall, when submitting their Tender, clearly describe any excluded work which of necessity they require to be executed and paid for by others. Any such work not specifically stated and described shall be deemed to have been included in the Tender.

2.3 Scope of Work

The Sub-contractor shall be responsible for all works detailed in the Specification and shown on the Tender Drawings, and in particular the following items: -

Undertaking specific detailed design as indicated herein.

Provision of co-ordinated CAD installation/working drawings for all services, builders work and detailed wiring diagrams for all equipment and control panels.

Inspecting all plant, equipment and materials as delivered or where specified at the manufacturers works.

Fixing or installing correctly all plant, equipment and materials.

Ensuring all associated work such as electrical wiring, connecting pipework, builders work, etc., is properly executed.

Testing and commissioning the complete installation including adjusting and balancing as necessary, and in line with the applicable British Standards for the various systems.

Demonstrating that the equipment is capable of the performance and method of operation specified to the satisfaction and acceptance of the Project Manager / Contract Administrator.

Demonstrating that the overall and complete systems perform correctly in the required manner and as intended by the Specification to the satisfaction and acceptance of the Project Manager / Contract Administrator (including return visits for seasonal tests).

Providing all installation/working, builders work and record drawings on CAD. Showing the complete installation and structure, architectural form and other services systems. All drawings must be provided on AutoCAD format with hard A1 copies, PDF copies and with fully bound AutoCAD DWG files being provided within the electronic O&M manual.

The Sub-contractor shall be responsible for making their own independent enquiries to make sure their CAD system is compatible with the systems being used by the Design Team. The Contractor shall ensure they has the capability to receive and issue drawings electronically both at site and at a main office.

Providing Operation Instructions and Maintenance Manuals for the complete systems as a word processed document and computer disk file. (Tender scheme to price for "Word for Windows", latest release).

Providing the full set of test results in an approved format for all tests, commissioning and balancing operations as a word processed document and computer disk file. (Tender scheme to price for "Word for Windows", latest release).

Instruct the Employers Staff in the use and operation and maintenance of the installations.

Handing over all specified tools, keys, spares, oils, chemicals, etc.

2.4 Discrepancies in Tender Documents

- Any queries relating to the Specification or the Drawings must be raised formally by the Tenderer, as per the instructions set out in the Tender Enquiry documents.
- In the event of discrepancies appearing in the drawings, or between the Drawings and Specification, or Drawings and Schedules, the Tenderer must raise these formally, as per the instructions set out in the Tender Enquiry documents.
- Where any conflict occurs between these General Requirements and the General Conditions of Contract, the General Conditions of Contract shall take priority and shall be at no additional cost. Any conflict must be raised formally by the Tenderer, as per the instructions set out in the Tender Enquiry documents.

2.5 Pricing of Preliminary Items

The cost of complying with this Specification must **NOT** be included within the rates for measured work.

A full breakdown of General Requirements pricing is to be provided with the submission of the Tender return and shall be detailed in the appropriate section of the pricing schedule.

2.6 Schedule of Rates

The Tenderer shall forward when required, a fully priced out Schedule of Rates with each item priced and totalled to agree with the sub-totals and final total of the Tender. These prices shall be the basis for the valuation of any variation of the Sub-Contract Works.

The priced Schedule of Rates shall be deemed to include for all items, whether mentioned in the Schedule or not, for this Sub-Contract. Detailed rates are also required for all Sub Trader's work included in the Sub-Contract.

Ancillary items not shown separately in the Schedule will be assumed to be included in the general rates stated.

2.7 Alternative Equipment Suppliers

The Tenderer shall include in their Tender for equipment supplied by one of the manufacturer(s) stated in the Specification.

Wherever products are specified by proprietary name, the phrase "or approved equivalent" is to be deemed included.

2.8 Orders for Materials

The Tenderer shall allow in their Tender price for the purchase of all materials and equipment from stockists and other suppliers at such time, and in such a manner as may be necessary to allow for the completion of the work in accordance with the Contract Programme.

Should the Tenderer foresee any difficulty with the delivery periods for the selected equipment, this should be clearly stated in their Tender return.

Additional costs resulting from non-compliance with the above shall be borne by the Tenderer.

2.9 Programme

The Tenderer is to provide with their Tender a preliminary programme. The programme shall be in the form of a bar chart or similar graphic representation identifying key dates, the sequences, dates and duration of the principle activities, including systems design development and submission and showing how it is proposed to carry out the works within the overall Contract period.

2.10 Staffing Chart

The Tenderer must include with their Tender their management proposals together with details of their supervisory Staff intended to be employed on the works. The Sub-contractors Management proposals may on acceptance of tender be incorporated into and form part of the Sub-Contract. Where the Sub-contractor has a design or design development responsibility their management proposals must include details of their design staff. The management proposals shall include the following information in respect of all supervisory/design staff:

- Organisation Chart - Both off and on Site
- Name
- Title and Function
- Relevant Experience and References
- Duration and percentage of employment on the Works

The above proposals shall include the Sub-contractors proposed Field Staff Organisation Chart showing lines of responsibility within the field staff and reporting lines of authority with key Head Office Managers/Directors with particular regard to Safety, Quality, Project Controls and Project Management.

The above information does not in any way relieve the Sub-contractor of the obligations to provide suitable and adequate management to complete the works.

2.11 Drawings and Specification

The Tenderer shall carefully and thoroughly examine the drawings and the Specification and fully acquaint himself with the work to be done, as no allowance for claims will be considered for any alleged deficiency of work or materials.

The Tenderer must as part of their Tender return, identify any equipment that they intend to select that causes any change of spatial requirements or allowances made in the Tender Scheme.

The Tender Drawings are prepared primarily to describe in a basic manner the design of the mechanical, electrical, and plumbing works, the working principles of the systems and the general intended methods of installation. They are intended to be read in conjunction with the Specification to facilitate the preparation of the Sub-contractors estimate and Tender and to enable all other participants to appreciate the interrelation of the mechanical, electrical, lift and plumbing works and the main works as a whole.

The Tender Drawings are accordingly part diagrammatic with runs of piping, ducts, cable, conduit and the like being shown to small scale and not necessarily indicating exact installation positions. However, the design is generally co-ordinated with the structure.

The Sub-contractor shall take their own dimensions for both the preparation of their Tender and for the execution of the work, and they alone shall be responsible for the accuracy of such dimensions and of drawings.

The Tender Drawings shall not be utilised exclusively for the detailed pricing of the works. The Tenderer shall allow for all necessary sets, bends, transformations and supports to complete the installation. Where the Sub-contractor elects to depart from the principles and general

arrangements depicted on the Tender Drawings they shall be responsible for undertaking detailed checks on the duties of all equipment affected, informing the Project Manager / Contract Administrator and adjusting the sizing of plant as required. The Sub-contractor shall not proceed with the order of re-sized equipment until they has provided the necessary calculations to the Project Manager / Contract Administrator. The Sub-contractor shall note that reduced size plant need not be accepted by the Project Manager / Contract Administrator and that all costs arising from such change shall remain the Sub-contractor's responsibility.

2.12 Contract Works

The Contract Documents shall be deemed to include, whether or not specifically mentioned or shown, any materials, accessories or works as may be necessary for the satisfactory completion of the Contract Works in accordance with accepted current practice or procedure.

2.13 Alternative Makes/Delivery Periods

The Tender shall be priced strictly in accordance with the Tender Documents.

The Sub-contractor shall ensure that the dates of deliveries covered by order placed with manufacturers, suppliers or other Sub-contractors are confirmed at regular periods between the placing of the orders and the date of delivery. To this end, a delivery schedule of all major items must be submitted to the Architect within 14 days of appointment of the Sub-contractor.

2.14 Safety, Health and Welfare of Workpeople on Site

The Contractor shall ensure that all safety and welfare measures required under or by virtue of the provisions of any enactment or regulations, or the working rules of any industry are strictly complied with.

The Contractors attention is drawn in particular to the following:

- The Construction (Design and Management) Regulations 2007
- The Construction (Lifting Operations) Regulations 1961
- The Construction (General Provisions) Regulations 1961
- The Construction (Working Places) Regulations 1966
- The Factories Act 1961 (S.1. 1969 No. 690)
- Health and Safety at Work Act 1974
- All amendments to the above Regulations

Industrial Safety Helmets to BS 2826 must be provided by the Contractor for all their personnel on site. The Contractor will be expected to use their best endeavours to ensure that helmets are worn where necessary by personnel on site.

The contractor can make use of the existing welfare facilities within the LMB. The contractor shall agree with the client the requirements for suitable attire within these areas.

2.15 Information to be Provided with Tender

The following information must be submitted at the time of Tender:

- Tenderers shall give the Manufacturer's name and catalogue reference or type, and expected delivery period for all the items of equipment.
- Tenderers shall give details of any work which the Contractor for Mechanical Services would require to let to a further Sub-contractor. In the event of there being such work, Tenderers are required to state the name of the proposed Sub-contractor and the successful Tenderer shall not employ any other Sub-contractor unless by permission of the Main Contractor.
- Tenderers shall give details of their thermal conductivity of the insulation on which their Tender is based.
- Tenderers shall give details of the electrical rating of the Electrical Equipment on which their Tender is based.

3.0 COMMENCEMENT AND COMPLETION

- The Sub-contractor shall execute their works within the dates described for the Main Contract. The Sub-contractor shall include in their price for any expenses they may incur in completing their works within this programme.
- The Sub-contractor's attention is drawn to the fact that their work in their Sub-Contract may well entail several visits to the site. No claim in respect of the number of visits to the site or discontinuity of the work will be entertained and the Sub-contractor shall allow in their rates for all extra costs incurred due to this method of working.
- The erection programme is to be agreed with the Main Contractor before any materials are delivered to site.
- The Sub-contractor in conjunction with the Main Contractor, will be required to submit a detailed programme of the works to the Project Manager / Contract Administrator. The overall time given must comply with the dates already given the Project Manager / Contract Administrator.

4.0 TENDER SURVEYS

Before submitting their Tender, Tenderer's are advised to undertake a site tour to ensure that they have a clear understanding of the environment that they will be working in and acquaint themselves with local conditions, means of access, the full extent and character of the operations, the supply of labour, proximity of adjacent structures and any other matters affecting the Tender as no claim on the grounds of want of knowledge in any respect will be allowed. Site tours must be arranged as per the details set out in the Tender Enquiry documents.

Prior to submitting their Tender to verify all matters that could affect their post Tender costs or works, the Tenderer shall be responsible for undertaking an inspection of the structural drawings and architectural drawings at the Offices of the relevant Design Team Member. No allowance can or will be made post Tender for any omission of works or cost arising from information available at the time of Tender. The arrangements to visit the Offices of the Design Team shall be made through the Project Manager / Contract Administrator. Application to visit should be made in the first week of receipt of the Tender.

The Tenderer is to allow in their prices for complying with all traffic and other regulations of the Project Manager / Contract Administrator, the Local Authority and Police with regard to access to and egress from the site as advised from time to time.

5.0 MANAGEMENT OF THE WORKS

5.1 Supervision

The Sub-contractor shall allow for keeping on the site, throughout the duration of the Sub-Contract and until the work is completed, a competent Project Engineer whose name shall have been communicated in writing to the Project Manager / Contract Administrator. This representative shall supervise and superintend the carrying out of the works on site, prepare progress schedules and programme and ensure full exchange of information with other trades and shall be permanently available during the working hours on the site and shall attend all meetings on the site when requested.

The site representative shall be fully authorised and qualified to accept written instruction from the Project Manager / Contract Administrator, and issue instructions on behalf of the Sub-contractor, and shall keep a diary recording the day-to day progress of the work and details of all the instructions received. This diary shall be at the disposal of the Project Manager / Contract Administrator.

If, in the opinion of the Project Manager / Contract Administrator, the degree of the site supervision is inadequate, they shall instruct the Sub-contractor via the Main Contractor, who shall immediately rectify this matter to the satisfaction of the Project Manager / Contract Administrator.

The Project Manager / Contract Administrator shall be at liberty (by notice in writing to the Sub-contractor), to object to any representative or persons employed by the Sub-contractor, in the execution of or otherwise about the works, who shall, misconduct himself or be incompetent or negligent, and the Sub-contractor shall remove such persons from the works forthwith. The Sub-contractor's Engineer responsible for the Sub-Contract works will be required to attend Site Meetings when requested.

5.2 Staff

The Sub-contractor shall supply all necessary labour, both skilled and unskilled, required to carry out the Contract and during the execution of the Contract.

6.0 PROGRAMME OF WORKS

Within 14 days of appointment the Sub-contractor is required to prepare and submit to the Main Contractor a detailed programme chart for the entire Contract, setting out the sequence of all operations and time limits within which it is proposed to commence and complete each operation. The programme is subject to the approval of the Project Manager / Contract Administrator. The programme shall clearly show the interdependencies of each and every activity and shall show all critical activities.

The "Works Programme" is to be rigidly adhered to and progress in all trades plotted weekly. Copies are to be sent to the Main Contractor and one up to date copy of to be displayed in the Sub-contractor's office. The Sub-contractor shall attend regular site meetings, convened at least fortnightly, under the chairmanship of the Main Contractor.

The Sub-contractor shall properly organise the work so as to fulfil the programme, co-ordinate and generally manage their work and deliveries from their suppliers.

The Sub-contractor shall keep on site full, up to date, records of the programmed installation activities showing the 'critical path' and a full equipment procurement schedule.

The procurement schedule provided by the Sub-contractor must declare all items of plant and equipment together with the following information:

- Delivery period from order to site
- Last instruction date
- Last order date
- Actual order date.

The procurement schedule 'last instruction date' shall be used by the Main Contractor as a record of the date up to which an instruction will cause no delay nor incur cancellation costs to the contract.

The Sub-contractor must furnish with their Tender return a first draft of the procurement schedule.

The Sub-contractor may revise the programme, critical path analysis and procurement schedule at any time but must publish the revision.

The programme, critical path analysis and procurement schedule must be in accord with the main contract programme, critical path and procurement.

7.0 ACCESS FOR PLANT INSTALLATION AND SUBSEQUENT REMOVAL

N/A

8.0 INSPECTION OF AREAS AND SUITABILITY OF OTHER WORK

N/A

9.0 EASE OF MAINTENANCE

The Sub-contractor shall at time give proper consideration to the future maintenance of the plant and shall include for such component parts as are provided by the manufacturer of equipment and plant for this purpose. Under this clause the Sub-contractor shall include for such items as; cleaning and access ports on pressure vessels and heat exchangers; easy access to oiling and greasing points; low level drain plugs and/or cocks in all vessels of plant or pipework fluids or gases.

Where pipes cross access routes at low level purpose made step-overs shall be installed to provide safe access.

This clause shall also cover the installation of equipment to give ease of subsequent removal of electric motors, thermostats, heat exchanger batteries, or other equipment, and of any other item to which it may be reasonably anticipated that maintenance would apply.

Every rotating, reciprocating or moving part of compressors, pumps, fans and other machines supplied by the Sub-contractors shall be properly protected by manufacturer's standard or purpose made machine guards to comply with current issue of the Factories Act. All machine guards shall be manufactured from solid sheet metal or wire mesh or iron frame, all galvanised after manufacture and shall be so designed with hinges and/or removable sections to allow for maintenance and all necessary tachometer readings.

10.0 STATUTORY REQUIREMENTS

10.1 General

The works shall comply with all current and relevant Statutory Instruments and Regulations including, but not limited to the following:

- Regulations under the Electricity Supply Regulations 1937
- Electricity at Work Act 1989
- The Health and Safety at Work Act

The works shall be carried out in accordance with the requirements and regulations of all relevant local authorities, fire brigades, and water, gas and electricity authorities.

Prior to installation of the works, it is the Sub-contractor's responsibility to ensure that their installations fully comply with the requirements of all statutory bodies. Any costs/programme implications associated with remedial works to installed works due to statutory authority requirements will be at the sole expense of the Sub-contractor.

Any such portion of the works requiring the inspection and approval of such authorities shall not be built-in, covered or otherwise obscured until such approval has been obtained.

Authorities shall be notified as necessary about the connection of electricity, gas, Telecom, water and drainage.

The Sub-contractor shall be responsible for liaison with the Main Contractor to facilitate the programme and co-ordination of the various utilities to meet their installation programme.

Unless otherwise specified, the whole of the works shall comply with the requirements of all relevant British Standard Codes of Practice.

10.2 CDM Regulations

The construction (Design and Management) Regulations 2015 apply to this project and the Sub-contractor shall be fully aware of the duties as laid down in these Regulations.

The CDM Co-ordinator shall provide a Health and Safety Plan to the Principal Contractor for this project, in this case the Main Contractor.

The Principal Contractor will be responsible for the development and implementation of the Health and Safety Plan during the construction phase.

The Sub-contractor shall ensure they obtain a copy of the Health and Safety Plan and any amendments and ensure that their personnel comply with any construction phase Health and Safety Rules as identified in the Plan and have been given suitable training.

The Sub-contractor shall ensure that the Planning Supervisor or Principal Contractor is provided with all the required information including Method Statements.

11.0 BUILDINGS AND SECURITY MEASURES

Provide, as necessary, temporary sheds, offices, other temporary buildings and security measures for your own exclusive use and clear away everything on completion.

12.0 TELEPHONES

N/A

13.0 FUEL POWER AND CONSUMABLES FOR THE ENGINEERING WORKS

Power and water to complete the installation shall be made available via the building existing supply. The contractor shall be responsible for ensuring these resources are consumed in a responsible manner; using energy efficient equipment, consuming only what is required to complete the works and switching off when not in use.

All consumables, filters, etc., shall be replaced as and when they are used within the requisite full complement of spares provided to the client at Completion or Completion of Section as defined in the Main Contract Preliminaries.

14.0 SECONDARY STEELWORK

The Sub-contractor shall include in their Tender for the design, supply and installation of all steelwork required to support the services within their works package including roof plant support steelwork and support steelwork for services within the risers.

15.0 SETTING OUT OF WORKS

The Sub-contractor shall set out the works and take all necessary site measurements to ensure that the works are built in accordance with the drawings and within the specified tolerances. The Sub-contractor shall be totally responsible for the accuracy of the setting out their works and of site measurement. The Sub-contractor shall, where required, check the setting out of other Contractors works which affect their own works.

The Sub-contractor will be held responsible for all costs arising from any error caused by their inaccurate setting out or failure to take site dimensions or errors in such site dimensions of failure to build within the specified tolerances.

The Main Contractor may check the Sub-contractor's setting out but this shall not relieve the Sub-contractor of their responsibility for any error made. Where discrepancies are found the Sub-contractor shall correct and reset out for further checking by the Main Contractor at no extra cost.

Before the work begins on site the Sub-contractor shall submit their proposed methods of dimensional setting out, construction and checking that will satisfy the accuracy's required by the Sub-Contract.

Setting out shall comply with BS 5964 as a minimum. Where this is in conflict with the Specification, the Specification will take precedence. Where permitted deviations are referred to in the Specification they are deemed to be a total deviation. Sub-contractors shall co-operate with other working in discreet areas to ensure that permitted deviations do not lead to out of tolerance dimensions between adjacent works.

Where systems to be installed under this Contract are to be run adjacent to or near to other systems the setting out of the services shall be the responsibility of the Sub-contractor.

16.0 SITE CLEANLINESS

N/A

17.0 INSPECTION BEFORE CONCEALMENT

Whenever work requiring inspection or testing is subsequently to be concealed, due notice shall be given to the Project Manager / Contract Administrator so that inspection may be made or tests witnessed before concealment.

Failure to give due notice, of at least 48 hours, shall necessitate the Sub-contractor uncovering the works and reinstating it as their own expense.

The Project Manager / Contract Administrator reserves the right to forego their inspection; this will in no way relieve the Contractors responsibility to comply with the Specification.

18.0 PLANT

The Sub-contractor shall include in their contract price for the provision of all tools, implements, instruments, machinery, cutting and bending machinery.

The Sub-contractor shall provide all special machinery and all tackle, tools and other equipment required for the execution of this work and will be held responsible for such equipment when on site.

Unless otherwise advised, all tools, etc, shall be suitable for operation on 110V 50Hz supply.

19.0 LOCAL AUTHORITIES REQUIREMENTS

19.1 General

The Sub-contractor shall comply with and give all notices required by any Act of Parliament, regulations or by-laws of any local authority, public services, company or authority who may have any jurisdiction with regard to the work or whose systems, the same, are or will be connected, and they shall pay and indemnify the Employer against any fees or charges legally demandable under such an Act of Parliament, regulations or by-laws in respect of the works. No extra charge will be allowed due to failure to allow for this requirement.

Where the requirements of any water or electricity authority call for submission to them of any component part of the works for approval, testing, stamping or certifying, the Sub-contractor shall, at their own expense, submit and deliver any such component part to the place required by such Authority.

After such component part has been satisfactorily approved, tested, stamped or certified, the Sub Contractor shall return it to the site for incorporation into the works. Any expense incurred shall be paid by the Sub-contractor.

19.2 Amendments

Any amendments to the Sub-Contract deemed necessary by a Statutory Undertaking or other Authority shall be submitted to the Project Manager / Contract Administrator prior to the work being executed.

20.0 INSPECTION AND TESTING AT WORKS

The Sub-contractor shall provide all assistance, labour, materials, apparatus and properly calibrated and certified instruments for carrying out the necessary works and shall allow in their Tender Sum for all costs in this regard.

The Project Manager / Contract Administrator shall be entitled at all times during the manufacture to inspect, examine and test on the Sub-contractor's premises the material and workmanship of all plant to be supplied under the Sub-contract and, if part of the said plant is being manufactured on other premises, the Sub-contractor shall obtain permission to inspect, examine and test as if the said plant were being manufactured on the Sub-contractor's premises. Such inspection, examination or testing, if made, shall not release the Sub-contractor from any obligation under the Sub-Contract.

The Sub-contractor shall give the Project Manager / Contract Administrator two weeks written notice of the date on and the place at which any plant will be ready for testing as provided in the Sub-Contract and unless the Project Manager / Contract Administrator shall attend at the place so named within ten days of the date which the Sub-contractor has stated in their notice, the Sub-contractor may proceed with the tests which shall be deemed to have been made in the Project Manager / Contract Administrator presence and shall forthwith forward to the Project Manager / Contract Administrator duly certified, copies of the test reading.

In the event of the plant not so passing the tests, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by him in repeating the tests.

21.0 CONNECTING TO EXISTING SERVICES

21.1 General

Given seven days' notice to the Project Manager / Contract Administrator of your intention to connect into or isolate any of the existing services and await their approval for so doing.

The Sub-contractor shall make arrangements to allow connection of the new works to existing including providing details of the proposed works and obtaining written approval as necessary.

Include for all overtime and other additional payments necessary to ensure that the interruptions to existing services are carried out with the minimum possible inconvenience. Work without pause until the services are back to normal.

21.2 Cost of Reconnections, etc

The Sub-contractor shall be responsible for any costs or charges for re-connections, re-visits, re-testing, etc, except for such charges arising from any written instruction by the Project Manager / Contract Administrator other than an instruction in respect of defective work.

21.3 General Facilities

The Sub-contractor shall arrange through the Main Contractor for facilities to be provided for the purpose of laying new mains and services and adjusting existing equipment.

The Sub-contractor shall ensure through the Main Contractor that the work of the Statutory Undertakings and other Authorities is complete prior to any covering up of the permanent works.

22.0 OPERATING OF PLANT, ETC

Prior to practical completion ensure that working plant is doing so correctly. Provide your own skilled personnel to attend the plant etc, while working, together with such specialist personnel as are necessary for each circumstance.

Should the services not perform as required the Contractor shall make all necessary alterations to ensure the environmental conditions are met, and the proving period is repeated for seven days. The monitoring shall be recorded via the BMS (assuming it is suitably calibrated and tested) or by stand-a-alone recorders for the full period (including humidity and temperature). Once satisfactory recording has been achieved for the proving period the Contractor shall issue these to the Engineer for review/comment.

23.0 PROTECTION OF EQUIPMENT

The installations shall be properly protected at all times, as required by the Main Contract preliminaries. Should the measures taken by the Sub-contractor prove to be inadequate, then it shall be the sole prerogative of the Project Manager / Contract Administrator to decide whether repairs may be effected and suitable recompense made to the Employer or whether damaged installations shall be completely replaced. It shall also be the sole prerogative of the Project Manager / Contract Administrator as to whether repairs are satisfactory and as to whether the equipment should be replaced. At no time is the Project Manager / Contract Administrator obliged to accept anything other than new totally undamaged, correctly installed and selected equipment. All costs for replacement remain with the Contractor.

24.0 FROST

N/A

25.0 SITE DOCUMENTATION

Notwithstanding the requirements of the Main Contract preliminaries, each Sub-contractor shall allow for and provide in a maintained, indexed library the following:

- Relevant copies of all technical equipment schedules "as delivered to site"
- Relevant technical literature on each type of equipment or component used within the installation
- Copies of all relevant information. (Technical queries, relevant instructions, current installation/working drawings, current programme)
- Copies of all signed day work sheets.

All of the above is to be accessible whilst the site is open for inspection by the Project Manager / Contract Administrator or their representative.

All of the above shall be kept up to date and in good order and must be maintained complete.

26.0 SITE CO-ORDINATION AND CO-OPERATION

Work by others will be in progress off and on site during the course of this Sub-Contract. The Sub-contractor shall collaborate with and integrate their installation with the work of others at all times and make themselves aware of the work of other trades to ensure that full collaboration and co-operation is maintained with the Main Contractor and other Sub-contractors at all times.

Co-ordination meetings may be held between relevant Sub-contractors and the Main Contractor at which the Sub-contractor is to be represented by Senior Personnel.

The Sub-contractor will be held liable for all extra expense caused by any failure on their part to properly integrate, programme or co-ordinate the works with the work of others.

27.0 REVISIONS AND VARIATIONS

Where schemes are subject to revision or instruction, the installation/working drawings, and finally the record drawings, must show the full effect of such revision. Where the scheme revision involves change to the architectural or structural details immediate notice must be given to the Project Manager / Contract Administrator.

Only if the Sub-contractor can give proof that a significant departure from the intent of the Tender Drawings has been necessary will a variation be recorded. This will neither include normal detail design development relating to inclusion of, nor development of, factors within the Sub-contractor's design responsibility.

Where scheme revisions are required due to the Sub-contractor's variation or revision then all cost for such revision will be the Sub-contractor's responsibility including the Design Team Consultants costs.

The Services Consultants Tender Drawings must not be used on site, all actual and proposed installations must be recorded accurately on a site set of drawings updated and available for inspection on site.

Where drawings are revised and updated during construction these shall be issued to the Project Manager / Contract Administrator for comments on the revision only.

28.0 DRAWINGS BY THE SUB-CONTRACTOR

28.1 Schedule of Sub-contractor's CAD Drawings

The Sub-contractor shall, within two weeks of appointment, prepare a drawing schedule of all their proposed drawings required for comment. The schedule shall indicate the following:

- Drawing number and revision number

- Drawing title and service
- Scale
- Latest date required on site
- Date required for final comments
- Date for submission of comments
- Date on which comments were received
- Date of commencement of drawing production.

The Sub-contractor shall revise and update their drawing schedule as necessary on a monthly basis taking into account any revision which may take place.

28.2 CAD Drawings by the Sub-contractor

The Sub-contractor shall provide the following drawings where applicable:

- Installation/Working Drawings
- Builders work Drawings
- Plant and Equipment Drawings
- Record Drawings
- Floor and Ceiling Drawings.

Drawings shall be to BS International A series.

All symbols shall be strictly in accordance with BS 1553.

Every drawing shall bear the name of the Contract as shown on the cover of this Specification.

Drawings shall be cross referenced for ease of interpretation.

All drawings shall be produced and presented on AutoCAD Release 2007 format.

All manufacturers' drawings and details shall be issued to the Project Manager / Contract Administrator for comment prior to manufacture. The final details including all technical aspects and calculations where applicable shall be submitted in a clear, definable and easily read format with the specified technical details, notes and performance data clearly shown.

All drawings shall be produced and presented in printed form and on computer disk using a CAD system conforming with the latest AutoCAD series system. All drawings shall have independent layers of information from the following minimum schedule:

- Structure and Architectural Form
- Mechanical Works with Pipework and Ductwork Installations displayed on separate Layers
- Electrical Power Installation including Floor Boxes
- Lighting Installation including Emergency Lighting
- Ancillary Electrical Works
- Drainage Works
- Water Services Works
- Fire Alarm Installation
- Data Cabling Installation
- Refrigerant Installation

- Plumbing Installation
- Lightning Protection

All shall be displayed "on screen" on different colours.

28.3 Production of Installation/Working CAD Drawings and CAD Builders work Drawings

The production of co-ordinated installation/working and co-ordinated composite builders work drawings requires that all Engineering Services Sub-contractors produce information in concert and to a master programme. Co-operate with the Main Contractor in planning the installation before the work commences. Take particular care to ensure that there is no obstruction of electrical services positions, cable routes, switch positions, mechanical services, pipework, access points and plumbing, etc. Arrange services in ducts so that the services are readily accessible for maintenance.

The routes of services and the approximate position of the equipment and the apparatus are shown on the Tender Drawings. Attend such meetings as are necessary to enable you to provide the Installation Drawings which the Main Contractor requires to process.

Inform the Project Manager / Contract Administrator before changing any component or detail of installation shown on the Tender Drawings or described elsewhere in these documents. At the time notify the Main Contractor of the total effect of these changes, including the design parameter of the system and their effect on power requirements, cable sizes, performance of rotating machines and ductwork or pipework resistance, etc.

It shall be the responsibility of the Mechanical Sub-contractor to attend and chair drawing production meetings and the individual responsibility of each of the Engineering System Sub-contractors to attend the same meetings.

The purpose of the meetings shall be to resolve the effective production of the CAD co-ordinated multi-disciplinary installation/working and builders work drawings and shall include but not be limited to the following:

- To establish the inter-relationship of services in such confined spaces as ceiling voids, ducts and plant rooms
- To allow adequate space for maintenance and access purposes
- To assist in the proper provision of builder's work drawings.

No allowance will be made for abortive drafting by any of the Sub-Contract packages due to lack of knowledge of each specific discipline requirements.

No drafting should proceed until each Sub-Contract has agreed an overall spatial relationship with the remaining Sub-Contracts and the architectural form and structure.

Any installation that proceeds either without a suitably produced and commented drawing or without detailed information of the other local Sub-Contract packages, structure or architectural form is entirely at the Sub-contractors' risk, no abortive costs will be allowed to rectify any problems arising.

Each of the Engineering Systems Sub-contractors shall produce independent working and builders work drawings, as specified elsewhere. Each Sub-contractor shall be responsible for the accuracy of their own information and for the physical relationship of their own works to the remainder.

The Services Sub-contractor shall allow for providing all necessary copies of their proposed working during all stages of production to the Main Contractor as required and for amending and re-submitting such drawings as necessary to achieve overall co-ordination.

The Sub-contractor shall allow in their programme for the preparation and obtaining approval of drawings, plus time to make any necessary amendments.

28.4 Mechanical Sub-contractors Additional Responsibilities

Notwithstanding the overall responsibility of the Main Contractor to programme and co-ordinate the entire works, the Mechanical Sub-contractor shall have the following particular additional responsibilities.

The Mechanical Sub-contractor shall be responsible for the overall co-ordination of all services installations, utilising all information provided for the structure, architectural form and mechanical, electrical and plumbing installations.

The Mechanical Sub-contractor shall also produce composite builders work drawings incorporating all services installation requirements with their own and all other contract package requirements properly defined.

The Mechanical Services Sub-contractor shall be responsible for and make all necessary allowance for, the receiving and checking of all other Sub-contractors co-ordinated drawings and timeously advising, confirming and agreeing with the said Sub-contractors and the Main Contractor any necessary alterations/changes/amendments in order to make these drawings fully co-ordinated.

The Mechanical Services Sub-contractor shall be responsible for and make all necessary allowance for, and demonstrate and ensure (with the Services Sub-contractors) that the services will be properly separated from one another so allowing installation and maintenance to be carried out in a proper workmanlike manner.

The Mechanical Services Sub-contractor shall make all necessary allowance for and identify in their Tender the cost for demonstrating the co-ordination of works described herein with all other services works.

The Mechanical Services Sub-contractor shall at Tender nominate and give a CV of their representative to be responsible for co-ordination of the works and who shall attend the site "co-ordination" meetings. Prior to the preparation of their co-ordinated working drawings they shall agree the following with the Services Sub-contractors and the Main Contractor:

- A schedule of all drawings to be prepared
- A programme (with other Sub-contractors) for the preparation of co-ordinated working

drawings.

The Mechanical Services Sub-contractor shall be responsible for and make all necessary allowance for producing a programme for the production of multi-service/zone drawings, determine priorities, lead the co-ordination services meetings, report weekly to the Main Contractor on co-ordination progress and supervise the timely production of co-ordinated drawings by each of the relevant Services Sub-contractors.

28.5 Other Engineering System Sub-Contractors Additional Responsibilities

The Engineering System Sub-contractors shall ensure that the Mechanical Sub-contractor is provided with all working and builders work drawings that they produce and shall have full responsibility for the programming and accuracy of their own information.

Each Services Installer shall incorporate sufficient reasonable programme periods and monies for the execution of their responsibility for the production of the installation drawings, no programme allowance can or will be made for non-compliance.

28.6 CAD Installation/Working Drawings

The Sub-contractor shall provide the appropriate installation/working drawings for the engineering services installations as described herein and in accordance with the agreed programme utilising CAD facilities. The Sub-contractor shall allow for all works associated with the preparation of fully co-ordinated working drawings and allow for amending, revising, updating for variations and generally updating their working drawings to achieve full co-ordination with the works for other Sub-contractors.

The installation/working drawings shall be based upon the latest contract issue of the Architectural and Structural drawings and any other drawings or information on trades or disciplines issued by the Main Contractor during construction. Drawings shall accurately show the specified or selected plant and equipment in their true proposed location.

Copies of manufacture's certified drawings shall be provided for major items of plant, indicating physical dimensions, schematic arrangements for components and full detailed electrical wiring diagrams.

The installation/working drawings shall show all plant, equipment and cable/conduit/pipe/duct runs and support details, etc. The drawings shall include full details of all plant together with cable/conduit/pipe/duct sizes, wiring drawings, schematic and inter-connection diagrams/drawings.

Unless otherwise agreed in writing, no work may commence until the relevant installation/working drawings have been through the drawing approval process and issued for construction.

Composite circuit and layout diagrams for the electrical wiring of plant, etc., shall not only detail all circuitry within main control panels but also that within all external equipment such as starters, thermostatic control devices, together with all interconnecting wiring from the main point of supply onwards and all terminal markings. The required sizes and types of all cables shall be indicated in the layout diagrams together with the ratings of such items as fuses, switches and control.

Circuit diagrams shall, where possible, be arranged so that the main sequence of events is from left to right and from top to bottom of the diagram. Symbols for diagrams shall comply generally with BS 3939. If abbreviations are employed for the designation of components, an integral schedule shall be provided on the drawings to explain the meaning of the abbreviations. The composite diagrams shall subsequently form part of the set of "As-Fitted" Drawings.

Individual circuit and layout drawings from the various component manufacturers will not be accepted in lieu of composite diagrams.

Where revisions take place to the Services Sub-Contract Works, either under the authority of an Project Manager / Contract Administrators Instruction, or by written agreement with the Main Contractor or when revised architectural or structural drawings are issued, the Contractor shall modify their drawings accordingly and shall re-issue for construction purposes any such modified drawings. The issue of revised drawings shall be in accordance with the with regard to the agreed programme for construction.

Specific installation drawings may with the prior specific and express written permission of the Project Manager / Contract Administrator omit minor details such as conduit provided that a Method Statement rigorously covers the installation intent. This permission will not be unreasonable withheld but will not be given where either Client operation or visual appearance is affected nor where details are needed for following trades.

The installation and working drawings must include details of all local co-ordination around equipment, control panels, individual plant at access points and on architecturally finished surfaces. The intent is that all installations can be considered for spatial relationship, appearance and Client operation.

The installation and working drawings must show sufficient detail to enable the erection Staff to install the works in accordance with the Specification and to show sufficient clearances for insulation, dismantling, maintenance insertion of thermostats, thermometers, gauges and the like, painting, cleaning and commissioning. Possible causes of obstruction or restriction, either structural or by other services, must also be shown to enable alternative routes to be considered. Electrical equipment and control items must be shown on the mechanical drawings.

Due to the integration of the services with the structure of the building, all installation and working drawings must be fully dimensions and produced at the following minimum scales: -

Floor layouts 1:50, Co-ordinated Sections 1:20, Plantroom 1:20, Builder's Work/Typical Details 1:20.

28.7 CAD Builders work Drawings

The Sub-contractor's attention is drawn to the fact that some builders work provision has already been made in the design due to the nature of the project and interface with the architectural and structural design. The Sub-contractor shall be required to produce installation/working drawings as detailed elsewhere and they will be required to detail their installation/working drawings around the builder's work information provided by the Project Manager / Contract Administrator. If the Sub-contractor considers it necessary to amend any builders work information they shall bring this to the attention of the Project Manager / Contract Administrator

who will amend their drawings if appropriate.

The Sub-contractor shall prepare all other necessary builders work drawings required for the execution of this Contract, making due reference to the structural and architectural final dimensioned detail drawings as applicable. All drawings must be fully dimensioned.

The Sub-contractor shall be required to mark on site actual locations of all builder's work holes through walls, partitions, floors, etc, and also chases in walls, floors, etc., for conduits, pipes and the like to bring to the attention of the Main Contractor prior to carrying out any work. The Sub-contractor shall establish a method of working with the Main Contractor to ensure the works may proceed without hindrance.

All builders work drawings provided by the Sub-contractor must be provided in sufficient time to comply with the agreed programme requirements and all costs arising from failure to do so will be met by the Sub-contractor.

28.8 Signature on Sub-contractors Drawings

Each drawing submitted by the Sub-contractor shall be signed by the Sub-contractor to confirm that:

- The work shown thereon has been co-ordinated with the work of others for which the Sub-contractor is responsible under the Sub-Contract Documentation
- The drawing does not contain any variations other than those authorised in writing by the Project Manager / Contract Administrator
- On re-submittal, all alterations made since initial submission have been clearly annotated on the drawing and listed separately down the right-hand side of the drawing.

28.9 Definition of Approval

The term "Approval" is for ease of identification only and the Sub-contractor is to note that any approval agreement, acceptance or comment, does not relieve or diminish the Sub-contractor in any way of their responsibilities and obligations under their Sub-Contract Agreement.

Understand that whenever you submit information to the Main Contractor, such approval will be given in principle only and will not, in anyway invalidate your responsibility for ensuring the accuracy and suitability of the information in accordance with requirements specified elsewhere.

The Project Manager / Contract Administrator will approve the overall layout of plant and equipment, ducting, pipework, cabling, trunking, conduit, etc, shown on the Installation Drawings, and their general location, as well as the type and size of these items, insofar as they conform to the Tender Drawings.

The exact portion in the works of the above items relative to grid lines, floors, beams, ceilings, walls and other structural items, and any other services is the Sub-contractor's responsibility and the Main Contractor's approval does not absolve the Sub-contractor from the necessity of checking these items.

When submitting any drawings, the Sub-contractor shall advise the Main Contractor if, in order to avoid delay in the completion of the works, early approval is necessary. All detailed drawings submitted for approval shall be to the specified scale.

Whenever possible comment by the Project Manager / Contract Administrator will be issued in less than the ten working days provided submissions by the Sub-contractor are made on a practical basis.

The Project Manager / Contract Administrator's representative will attend a series of joint discussion meetings during the production of the co-ordinated composite working/installation and builders work drawings to provide early comment upon presentation, detail, design queries and production programme.

The Project Manager / Contract Administrator's representative will co-ordinate the response from all members of the Client Consultant team to meet with the required ten working day period.

All drawings produced by the Sub-contractor shall be commented upon by the Project Manager / Contract Administrator before they can be used for constructional purposes. The Sub-contractor shall issue their drawings for comment in a logical manner related to the construction programme and grouped accordingly to service.

The comment procedure shall entail the Project Manager / Contract Administrator applying a status to each of the Sub-contractor's drawings.

Drawings Stamped Category "A"

Installation, manufacture or construction may proceed in accordance with the drawings submitted. Unless indicated to the contrary on such drawings, the works shall comply with the Contract Documents.

Drawings Stamped Category "B"

Installation, manufacture or construction may proceed in accordance with the drawings submitted subject to the Sub-contractor taking necessary action based on the Design teams' comments and all annotations added to the returned drawings. Unless indicated to the contrary on such drawings, the work shall comply with the Contract Documents. The required number of copies of the amended drawings shall be sent to the Project Manager / Contract Administrator.

Drawings Stamped Category "C"

No work shall be installed, manufactured or constructed. The Sub-contractor shall re-submit new shop drawings to the Project Manager / Contract Administrator for review until re-submission is not required. Any submission marked "C" shall not be permitted on site.

The co-ordinated, returned drawings will incorporate the most onerous classification awarded by any consultant making comment.

The intention of this comment procedure is that all drawings should obtain Status "A".

Any modification or amendment to these drawings or works installed caused through lack of co-ordination, or at the request of the Main Contractor in order to ensure that they fulfil the Contract Conditions, shall be at the expense of the Services Sub-contractor and shall not involve the Employer or Main Contractor in any additional expenditure.

Any work adjudged by the Project Manager / Contract Administrator to be "unnecessary" and caused by inaccuracy of "approved for construction" drawings, marking out, or any other default of the Sub-contractor, shall be paid for either by the Services Sub-contractor or other Sub-contractor as deemed appropriate by the Main Contractor. Such work may include repairing, replacing, making good, taking down and rebuilding, of any part of the building, plant and other works and re-drawing as may be affected by such "unnecessary" work.

29.0 RESPONSIBILITIES - SERVICES CO-ORDINATION & SUB-CONTRACTOR DESIGN ELEMENTS

29.1 Services Co-ordination

The Sub-contractor shall be responsible for the full co-ordination and proper execution and completion of the installations detailed as their responsibility within the contract specification and drawings and shall ensure that it is co-ordinated and compatible with the remainder of the project design. The positions of equipment, pipework, valves etc, indicated on the drawings are given for tendering purposes only and the exact co-ordinated positions shall be proposed by the Sub-contractor for approval by the Project Manager / Contract Administrator. The Sub-contractor's tender price shall include for any modifications that may be necessary to provide fully co-ordinated and installed engineering services.

The Sub-contractor shall take their own dimensions for both the preparation of their Tender and for the execution of the work, and they alone shall be responsible for the accuracy of such dimensions and of drawings made there from.

The tender drawings shall not be utilised exclusively for the detailed pricing of the works. The Tenderer shall allow for all necessary sets, bends, transformations and supports to complete the installation. Where the Sub-contractor elects to depart from the principles and general arrangements depicted on the tender drawings they shall be responsible for undertaking detailed checks on the duties of all equipment affected, informing the Project Manager / Contract Administrator and adjusting the sizing of plant as required. The Sub-contractor shall not proceed with the order of resized equipment until they has provided the necessary calculations to the Project Manager / Contract Administrator. The Sub-contractor shall note that reduced size plant need not be accepted by the Project Manager / Contract Administrator and that all costs arising from such change shall remain the Contractors responsibility.

The Tender drawings for each of the engineering services installations do not indicate the presence of other engineering services or supports for suspended ceilings, etc. The Sub-contractor is responsible for ensuring liaison with all trades to ensure that all engineering services are accommodated satisfactorily in the building, particularly in ducts, voids, cavities, and other potentially congested areas. The Sub-contractor shall, without cost to the Employer, make any alterations that may be found necessary due to non-compliance with this clause.

The Sub-contractor shall acquaint himself with the general arrangement of all services and ensure that in fixing any work it will not obstruct the fixing or future maintenance of any other services. They shall also co-ordinate the engineering services with other trades and take all

necessary precaution to ensure that the progress of any trade does not impeded the progress of any other trade that all engineering services are accommodated satisfactorily.

The Sub-contractor shall allow for obtaining and co-ordinating the submission of fully co-ordinated engineering services installation drawings and shop drawings from all their Sub-contractors' and suppliers and all related builders work drawings. The drawings are to be compatible, correctly annotated and cross-referenced at their interfaces.

The Sub-contractor shall agree with all their Sub-contractors' and suppliers and be responsible for the positions of their work or materials including pipe runs in ducts, conduits and cables, etc and the positions of holes, chases, recesses, fixing and the like, before work is put in hand, in order to ensure that they do not conflict with other work.

The Sub-contractor shall be responsible for taking all their own dimensions on site, checking levels and marking out for the builder's work and shall allow for such work in their Tender. The Sub-contractor shall ensure that setting out of plant and equipment, pipes and ducts, etc permits it to fit into the space allocated and allow access for maintenance and replacement purposes.

To ensure co-ordination between their Sub-contractors' and suppliers the Sub-contractor shall allow for arranging and attending any necessary meetings with the relevant Sub-contractors' and/or suppliers in order to agreed such priorities as are necessary and in order to monitor progress, obtaining the necessary data for and preparing co-ordinated drawings of all the work involved in the engineering services installation together with its associated builders work and giving all necessary instructions to overcome any potential conflicts. Where such co-ordination requires any amendment to the drawings or specifications prepared by the Employer's Consultants, the matter shall be referred to the Main Contractor in the first instance.

These activities shall be carried out to ensure that any amendments or revisions to data can be implemented without delaying progress of any part of the Works. The Sub-contractor shall allow for the costs of all amendments or revisions required to provide a properly co-ordinated engineering services installation.

Each Sub-contractor shall incorporate sufficient reasonable programme periods and monies for the execution of their responsibility of the installation drawings, no programme allowance can or will be made for non-compliance.

As for the installation/working and builders work drawings, the Mechanical Sub-contractor shall produce composite drawings with their own and all other contract package requirements properly defined.

No allowance will be made for abortive drafting by any of the Sub-Contract packages due to lack of knowledge of each specific discipline's requirements.

No drafting should proceed until each Sub-Contract has agreed overall spatial relationship with the remaining Sub-Contracts and the remaining form and structure.

Any installation that proceeds either without a suitably produced and commented drawing or without detailed information of the other local Sub-Contract packages, structure or architectural form is entirely at the Sub-contractor's risk, no abortive costs will be allowed to rectify any problems arising.

Where scheme revisions are required in the Main Contract works or other Sub-Contract works due to the Sub-contractor's variation or revision then the costs for such revision will be the Sub-contractor's responsibility include the design team consultant's costs.

Comments by the Project Manager / Contract Administrator shall not relieve the Sub-contractor of their responsibility for the suitability and correctness of the Sub-contractor's design and their other obligations within the contract documentation.

The Sub-contractor shall be responsible for an omission, errors or any discrepancies in the drawings and other particulars supplied by him or their suppliers, whether such drawings or particulars have been commented upon by the Project Manager / Contract Administrator or not, provided that such omission, errors or discrepancies are not due to inaccurate information of particulars furnished in writing to the Sub-contractor by the Project Manager / Contract Administrator.

29.2 Contractor Design Items

The Installer's design obligations shall include, but not be limited to, as applicable to their Sub-Contract package, the following and as detailed within their own specific specifications:

Fabrication drawings and the co-ordinated installation working drawings and record drawings.

Drain and vent point locations and pipework gradients in accordance with BSRIA documents Application Guide 1/89 Flushing and cleaning of Water Systems.

Secondary steel supports for containment and pipework e.g. roof unistrut goal post arrangements etc

Bracket and support detailed design and locations. (All types, loads and locations must be declared to the Main Contractor prior to installation for comment (minimum 10 working days but to be agreed between the Main Contractor and the Sub-Contractor)).

Details of Electrical wiring diagrams of all equipment supplied by the Installer showing all interconnections between equipment to enable the necessary wiring to be undertaken.

Details of all equipment component design and selection necessary insofar as such items have been selected by the Sub-contractor for that item of equipment to meet the engineering specification and performance indicated.

Automatic controls (BMS) detailed design insofar as it is required to meet with full physical and operational requirements of the Engineering Specification. The Sub-contractor shall be responsible for ensuring the full capability of the plant and equipment with the specified function. Where interface (relays or other devices or modifications to hardware or software) are required the design and incorporations shall be the Sub-contractor's responsibility.

Dimensioning of, and final installation details of, the Automatic Control panels to suit the detailed requirement of the particular agreed manufacturer of controls equipment and cable entry/exit accommodation such that:

- Cable entry is possible in the selected location
- Doors are not fouled by other plant, equipment, services or structural elements
- Safe operating and maintenance clearances are provided in all access positions when installed on site.

Design of elements of the scheme provided by the Sub-contractor for self-weight and other applied forces/loadings in reasonable use. In particular any buried tanks or pipework will require designed anchorage encasement or foundations.

Pipework thermal expansion accommodation and anchorage, including provision of bellows or bends.

Plant supports, step-overs and gantries to provide safe access over services installed within circulation routes in plant rooms etc

Valve, damper and access locations.

System water capacities and chemical additives - and arranging of the facilities required by BSRIA Application Guide 8/91 pre-commissioning of cleaning of water system.

Selection of all anti-vibration mountings to suit the particular application of the mounts.

Final locations of control sensors, detectors and thermostats.

Capacity, location and design of electrical conduit system, similarly trunking where used in lieu of multi-conduit installation.

Duct platforms, access covers and gratings, ladders and additional structural steelwork where required and detailed in the Sub-Contract documentation.

Selection of regulation devices to comply with CIBSE Technical Memorandum TM8.

Sizing of cable terminations on items of equipment provided under the Sub-Contract where cable sizes are specified.

Ensuring cable sizing selections as specified.

Ensuring cable sizing selections as specified are not invalidated by Sub-contractor selection of alternative routes during installation.

Detailed design of earthing and bonding requirements for electrical engineering services, mechanical engineering services, architectural and structural elements requiring earthing and bonding.

Design of cable or cable trunking terminations on to electrical equipment provided under the

Sub-Contract and dimensioning of and final installation details of electrical switchgear to ensure that:

- Cable entry is possible in the selected location.
- Doors are not fouled by other plant, equipment, services or structural elements.
- Safe operating and maintenance clearances are provided in all access positions when installed on site.

Fuse sizes installed in plug tops are appropriate for the rating of connected equipment.

The Sub-contractor shall include within their tender for the supply and installation of any components associated with the above design requirements which may not necessarily be detailed on the tender drawings or in the tender specification.

The contractor is required to produce a complete package of information for review and comment by the design team for each contractor design package. The information produced must include as a minimum (but is not restricted to)

- A system description
- A system control writes up detailing system control philosophy
- System layout drawings
- System schematic/isometric
- Technical submittals for all system equipment with technical details, dimensions and equipment images

The contractor is responsible for the production of each CDP package in line with the programme of works providing sufficient time (min 7 working days) to allow the design team to review and suitably comment.

30.0 QUALITY STANDARDS/CONTROL

30.1 Quality Assurance Procedures

The Sub-contractor shall provide for agreement by the Main Contractor a fully documented Quality Assurance Procedure (QAP) in accordance with BS EN ISO 9001, prior to commencement of draughting, procurement or installation.

The Sub-contractors QAP must be provided in concert and agreement with the main contract procedures.

The QAP must detail specific procedures related to the tendered project and not be generalised.

The QAP shall be provided by the Sub-contractor at Tender, its content subject only to the Main Contractor's comment.

30.2 Regulations

Materials, products and completed systems in the Sub-contractors works shall comply with at least the following:

- This Specification
- Health and Safety at Work Act
- Home Office Rules
- Local Authorities By-Laws and Regulations
- Water Supply Authority Requirements
- Electricity Supply Authority Requirements
- Gas Supply Authority Requirements
- Fire Prevention Officers Requirements
- Loss Prevention Council Regulations
- Any other Special Licensing Authority Requirements
- Appropriate British Standard Specifications and Codes of Practice
- Regulations for the Electrical Equipment of Building (IEE Regulations)
- Gas Safety Regulations

The Sub-contractor shall notify the Project Manager / Contract Administrator of any revisions or addition to the foregoing as they are published during the installation of the works. The Project Manager / Contract Administrator will give appropriate instructions in each case.

The Sub-contractor shall pay all charges made by an Authority approving any part of the Sub-Contract Works.

30.3 Equipment and Plant Performance Guarantees

Where equipment and plant performance data and duties are identified in the specification, the Sub-contractor shall thoroughly check that the equipment offered by the manufacturer complies in every respect with the detailed materials and performance specification given. They shall obtain a written undertaking from the selected manufacturer that all aspects of the stated specification are achieved.

The Sub-contractor's attention is drawn to the fact that more than one clause of the specification may cover the total performance of the equipment and they shall therefore ensure that their supplier obtains, or has seen, all sections of the specification prior to giving the written guarantee of performance.

All of the equipment scheduled in the Engineering Systems Installation documents shall require a performance guarantee. The Sub-contractor shall prepare a Schedule of Guarantees which for each item shall give (a) manufacturer (b) equipment (c) dates of guarantees.

30.4 Manufacturer's Guarantees and Warranties

All manufacturer's guarantees and warranties on plant, equipment etc, shall be valid up to the end of Defects Liability Period.

All equipment normally guaranteed by the Manufacturer for a period of time which goes beyond the end of the Defects Liability Period shall be held to remain under guarantee for the maximum period.

For Contractor Design Portions refer to the Main Contract Preliminaries for details of general M&E & Lifts design Warranties required

Provide two copies of all such guarantees to the Project Manager / Contract Administrator. In addition, copies shall be included in the Operation and Maintenance Manuals.

30.5 Technical Method Statements

In advance of any works being carried out on site, the Sub-contractor shall submit for comment by the Project Manager / Contract Administrator a Technical Method Statement.

Technical Method Statement shall be provided for the following aspects of the installation:

- Operating and Maintenance Manuals
- Record Drawings
- Installation/Working Drawings
- Thermal Insulation
- Commissioning and Testing
- Pipework Installation
- Automatic Control Installation
- Electrical Installation
- Plantroom Installation
- Quality Control and Samples Procedures
- Installer Liaison Procedures
- TQ (Technical Query) Procedures

30.6 Samples

Samples for appraisal shall be provided for all items which may be viewed in or on the building within the normally occupied space or on the exterior.

Samples shall also be provided for the following but shall not be limited to:

- Internal finishes
- Grilles, diffusers and external louvres
- Thermal and acoustic insulation
- Room mounted control sensors
- Luminaires
- Dado/Skirting trunking
- Floor outlet boxes
- Wiring accessories
- All labelling
- Typical record drawings and manuals

Each Sub-contractor shall prepare a Schedule of Samples for approval.

The Sub-contractor shall ensure that:

- Orders for such materials or articles will not be confirmed until approval has been given.
- Approved samples shall be retained at a location approved by the Project Manager / Contract Administrator for comparison with materials/articles used in the Works. The Sub-

contractor shall remove or dispose of samples only when instructed.

- Samples of finished work shall be prepared when specified and obtain approval before proceeding with the Works.
- All costs of providing samples shall be borne by the Sub-contractor.

Samples of fittings, materials, sub-assemblies and completed assemblies must be approved by the Project Manager / Contract Administrator at appropriate and agreed stages before final production is started. (Refer to Specific Specifications). Samples are to be an accurate representation of the finished product/installation and shall be adequately protected and maintained.

In cases where a range of colour, grain, texture, or other characteristics may be anticipated in finished products, a sufficient number of samples of the specified materials shall be furnished by the Sub-contractor to indicate the full range of such characteristic which will be present in the finished products; any such products delivered or erected without submission and prior to written approval of a full range of samples may be subject to rejection by the Project Manager / Contract Administrator. Any products not conforming to the approved range of samples will be rejected.

The Sub-contractor will arrange for the Employer/Project Manager / Contract Administrator and/or their representatives to visit an installation of a comparable nature to their proposed scheme and submit details of this with the Tender.

The Project Manager / Contract Administrator may withhold approval of working drawings until satisfactory samples have been submitted and agreed.

The samples will be separate from and not part of the final works, unless otherwise agreed with the Project Manager / Contract Administrator. Samples shall be provided in such time as to allow comments to be incorporated and the final works executed to meet the overall programme of the Main Contract.

All samples shall be marked, tagged, or otherwise properly identified with the name of the supplier, the name of the project, the purpose for which the samples are submitted, and that date, and shall be accompanied by a letter of transmittal containing similar information. Each tag or sticker shall have a clear space for stamping and signing. Once approved no other alternative may be used for the Works unless formally approved.

30.7 Suitability of Materials

Materials and components shall be supplied to suit the climatic conditions and other conditions of use to which the materials and components will be exposed during the installation process and after it is completed and must also be suitable to withstand any test specified herein or in any document referred to herein.

30.8 Materials and Workmanship

Materials and workmanship shall be the best of their respective kinds in accordance with the specification. All materials shall (unless otherwise stated) conform to the statutory requirements

detailed herein. The installation shall be constructed for entirely new materials and equipment.

Unless stated otherwise all materials and articles are to be of new manufacture.

The Sub-contractor shall use materials of merchantable quality and carry out the Works to a high standard of workmanship and to the satisfaction of the Project Manager / Contract Administrator. All materials shall be in accordance with the Building Regulations and the relevant current British Standards, Code of Practice, Drafts for Development, and Building Research Establishment recommendations.

Where there is in existence a relevant British Standard, BS code of practice, draft BS, DIN Standard, ISO Standard or British Board of Agreement certificate applicable to the design, execution or performance of the Works or any part thereof then the recommendations and requirements of such documents shall be considered a minimum standard for the work described and must be complied with. Should two standards conflict the Sub-contractor should draw attention to this and at tender stage and state the option chosen.

A Sub-contractor offering a product will be required to provide, in English, technical or other details of the approval gained by the product and its qualifying tests. Where more than one alternative standard is necessary to ensure complete coverage of a design specification the Sub-contractor shall prepare a comprehensive document encompassing the recommendation and requirements of the original standard. Any re-design and any costs incurred by the Design Team will be at the Sub-contractor's expense.

Materials or articles specified to comply with a BS shall be clearly and indelibly marked with the reference specified wherever possible. The position of such marking shall however be subject to approval. Where marking is impracticable the relevant advice/delivery notes shall include the BS reference with which they are to comply. The Sub-contractor will provide certificates of compliance with the BS when required by the Project Manager / Contract Administrator.

Where more than one manufacturer is able to supply any particular material or article, the Sub-contractor shall obtain the whole quantity required to complete the work, including spares where required, from one manufacturer or supplier, or obtain prior approval to multi-sourcing or to any change in the source of supply. The Sub-contractor shall produce written evidence of the sources of supply when requested by the Project Manager / Contract Administrator.

All materials are to be transported, unloaded, stacked, stored and fixed or applied by the Sub-contractor in strict accordance with manufacturers' instructions, including relevant safety precautions.

In cases of any difference or conflict between the requirements of the manufacturers' instructions or specifications and the technical sections of the Specification, the Sub-contractor shall identify the difference involved and seek instruction from the Project Manager / Contract Administrator.

The Sub-contractor shall make available for inspection by the Project Manager / Contract Administrator when required, copies of orders to suppliers.

The Installation, unless stated, shall be designed and constructed of materials used in such manner that they shall be resistant to corrosion, particularly bimetallic corrosion, galvanic action,

distortion, swelling or rot resulting from the presence of moisture, air and differing external climatic conditions and internal environmental conditions. This shall include corrosion from snow, hail, ice, rain contaminates (eg. oxides of nitrogen and sulphur), dust or plants.

All materials used in the system will be resistant to the growth of fungi and micro-organisms and to attack by insects, animals or birds. Where required to design the Works, the Works Contractor will confirm what preventative measures have been taken to ensure resistance to such attack.

The Installation will not contain any toxic materials which by physical contact or by inhalation of gases could prove harmful to the occupants of the building.

The materials used in the Installation will not give off any odours.

All materials considered by the Project Manager / Contract Administrator to be unsound, or not in accordance with the Specification, shall be immediately removed by the Sub-contractor at their own expense, and all work carried out imperfectly or with faulty materials must be removed by the Sub-contractor at their own expense, and properly replaced by the Sub-contractor to the satisfaction of the Project Manager / Contract Administrator. Should the Sub-contractor neglect or refuse to do this, the Project Manager / Contract Administrator shall have the power to employ other persons for this purpose and to pay the same out of any monies that may be or shall become due to the Sub-contractor, or may recover the amount of such expense by action at law.

The Project Manager / Contract Administrator will, in addition, require at all reasonable times to inspect any drawings or portion of the plant contracted for at the works of the manufacturer.

Where selected by the Sub-contractor, all equipment and materials shall be provided by manufacturers who have available maintenance and servicing capability within the United Kingdom as appropriate.

30.9 Ordering Materials and Products

The Sub-contractor shall order the necessary materials and products immediately upon the Main Contractor instructing the Sub-Contract works or any part thereof, to proceed. The Sub-contractor must not delay Practical Completion, or completion of any part of the works, by delays in ordering or delivery of materials and products.

The Sub-contractor is to advise in good time when items of plant and equipment are required to be placed on order, to ensure their timely installation into the works.

To avoid any possible delays to Practical Completion the Sub-contractor may submit details of alternative manufacturers or types of materials and products for consideration by the Project Manager / Contract Administrator. The Project Manager / Contract Administrator will give appropriate instruction in each case.

31.0 PROTECTION OF THE WORKS

31.1 General

The Sub-contractor shall provide adequate protective measures to prevent wilful, accidental or resultant damage to the works and any other items liable to be damaged. The Sub-contractor will be responsible for the adequacy and maintenance of the protection, including its Fire Resistance, afforded. Replacement parts or equipment or making good will not be accepted in lieu of protective measures.

The Sub-contractor shall diligently carry out the works so as not to injure any person or persons, any property or belongings of any person or persons and shall take all necessary protective measures to ensure their safety.

The Sub-contractor shall, as necessary, include for maintaining, altering and adapting the protective measures as the work proceeds and shall provide all information necessary for the Main Contractor to continue to maintain the protective measures following departure of the Sub-contractor to practical completion of the Project.

If present at the time of practical completion the Sub-contractor shall allow for removing all their protective measures, taking care not to damage the Works and thoroughly clean down and prepare the Works for handover and immediately remove all protective materials or equipment from the Project. If the Sub-contractor is not resident on site at this time then detailed information should be provided to the Main Contractor to permit others to remove the protective measures without damage to persons or property.

The Sub-contractor is to state in detail in their Tender Method statement the methods they proposed to adopt to carry out their responsibilities for protective measures.

The Sub-contractor is to provide all necessary coverings, screens, blankets, temporary heating or the like, required to protect any work or materials liable to be damaged by frost, high winds, excessive humidity etc. All protective measures shall be adequate for the purposes required.

31.2 Handling and Storage of Materials and Products

All installation materials, component parts or complete items of equipment shall be delivered and stored on site in properly designed and constructed containers or packing to give protection against transportation and handling damage and deterioration during storage. The packing shall be weatherproof. If damage to materials takes place prior to the incorporation within the Works, due to inadequate protection being provided by the Sub-contractor, such materials will be replaced at the total expense of the Sub-contractor.

The Sub-contractor shall:

- Deliver, off-load, store and transport about the works all materials and products in the manner recommend by their manufacturer
- Examine all materials and equipment supplied under this contract on delivery to site and immediately prior to installation. Any material or equipment which is damaged or faulty

shall be replaced

- Equipment or component parts of equipment specifically designed to operate in normal room conditions, shall be delivered to and stored on site with suitable waterproof protection
- Take particular care to protect component parts specifically designed to act as heat transfer surfaces. These surfaces shall have purpose designed packing to protect them whilst in transit and storage on site
- Provide adequate safe, covered storage and protection for all new materials and products
- Store pipework and similar products on properly made racks and adequately support to prevent bending and distortion
- Completely cover the valve ports and end of pipes or plug to prevent the ingress of foreign matter and additionally protect flanges against damage to the flange surface
- Store gaskets carefully to avoid damage. Rubber gaskets shall be stored in a cool place, free from draughts or placed in boxes containing powdered chalk and stored in a cool, dry place
- Protect electrical cables from physical damage and seal ends
- Where materials and products cannot be stored in dry buildings they shall be raised clear of the ground and supported. They shall be protected from damage by frost, water and building work with covers of appropriate means. Materials and products must not be stored by placing directly on earth or any other damp or corrosive surface
- Materials and products shall be adequately coated to prevent damage by oxidation, etc and this coating shall be maintained until ready for final finishing.

31.3 Protection to Fixed and Unfixed Items of Plant

The Sub-contractor is to take all measures necessary to screen and protect all plant, equipment and accessories, whether in storage, in course of erection or erected, from the ingress of dust, moisture or foreign bodies, or from damage or marking by other trades to Practical Completion of the Sub-Contract works.

Failure to arrange for such protection will make the Sub-contractor liable for all consequent reinstatement.

All parts of the installation liable to corrosion are to be properly cleaned and painted with heat resistant and/or corrosion resistant paint at works and a further coat immediately after erection.

Any plant, equipment and accessories found to be unduly marked by tools or damaged, corroded or distorted by any cause will be rejected by the Project Manager / Contract Administrator and must be replaced by the Sub-contractor at their own expense.

Final painting or finishing coats will be carried out by the Main Contractor unless otherwise

indicated in the Particulars Specification hereinafter.

When final finishes are provided to equipment at Manufacturer's works, all such finishes are to be of an approved material, process and colour and the Sub-contractor shall ensure adequate provision for the protection during transit, storage during and after erection to avoid damage to the finishes. The Sub-contractor shall inspect all paint and equipment immediately on delivery and shall not accept any that are damaged.

The Project Manager / Contract Administrator must be notified and the damaged works be subject to inspection before remedial work commences.

The Sub-contractor shall be responsible for the protection of their work during execution, but the Main Contractor may be responsible for necessary casing and protection after the Sub-contractor's work has been executed to the satisfaction of the Main Contractor.

31.4 Care of the Project

The Sub-contractor is to ensure that their operatives or operations do not damage other Sub-contractors Works or any other part of the Project or any protective measures. Any operative found wilfully damaging the Project will be liable to instant removal from the Project.

31.5 Care of Finished Surfaces

The Sub-contractor shall where necessary provide, maintain and remove immediately when no longer required suitable adequate secondary protection to any finished surface on or over which the Sub-contractor requires to carry out their works and shall be responsible for any resultant damage that might occur to the finished surface or primary protection. Damage by others, unless agreed otherwise with the Project Manager / Contract Administrator is the responsibility of the supplying Sub-Contract.

31.6 Adaptation of Existing Protection

The Sub-contractor shall request instruction from the Main Contractor before removal of any protection to the work of others, and shall to the satisfaction of the Project Manager / Contract Administrator, replace that protection where required ensuring the integrity and purpose is maintained.

31.7 Moisture

The Sub-contractor shall prevent the Works from becoming wet or damp where this may cause damage and shall dry out the Works thoroughly. They shall control the drying out and humidity (paraffin heaters are not permitted) of the Works and the application of heat to prevent:

- Blistering and failure to adhesion
- Damage due to trapped moisture
- Excess movement

32.0 TRIAL AREA

N/A

33.0 DRYING OUT

N/A

34.0 BLANK ENDS

During erection all open ends of pipes, conduits, etc., must be properly capped or plugged. The Contractor shall include for all such plugs and also plugs, spades and caps for Sectional Testing as required. All pipework to be thoroughly cleaned of all rubble, cement droppings, etc., before testing.

35.0 PROHIBITED MATERIALS

The Contractor shall ensure that they does not use, specify, select and/or approve for use any materials, substance or building practice or technique not in accordance with British or European Standards and Codes of Practice published at time of such specification, use, selection and/or approval or otherwise generally known within their profession at the time of specification, selection, approval or use (as the case may be) to be deleterious or hazardous to health and safety or detrimental to the structure, fabric, or durability of a project in the particular circumstances in which such materials, substance, building practices or techniques are used including but not limited to substances, materials, products, techniques or methods which have been publicised in the Building Research Establishment Digest as amended from time to time as being deleterious to health and safety or to the durability of property in the circumstances in which they are used.

The Contractor shall advise the Main Contractor should they become aware of any materials being used in connection with the project which are not in accordance with relevant British or European Standards and Codes of Practice at the time or otherwise generally known to be deleterious or hazardous to health and safety or detrimental to the structure, fabric or durability of the project including but not limited to substances, materials, products, techniques or methods which have been publicised in the Building Research Establishment Digest as amended from time to time as being deleterious to health and safety or to the durability of property in the circumstances in which they are used.

The Contractor will have regard and take due note of the recommendations contained in the published guidance issued by Ove Arup entitled "Good Practice in the selection of construction materials" dated 1997 sponsored by the British Property Confederation and British Council of Offices when complying with the requirements of this clause.

The Contractor shall ensure that they does not use, select or specify any insulating material that uses CFCs or HCFCs in either manufacture or composition.

36.0 HOUSEKEEPING

It shall be the Contractors responsibility to keep their working area clean and tidy at all times and remove all rubbish to a dump or other place on the site on an agreed regular basis.

37.0 SPARE PARTS AND TOOLS

37.1 Additional Spare Parts

Wherever spares or tools, special or otherwise, are required by other clauses within the Specification they shall be provided irrespective of the requirement of this particular section.

28 Days prior to Practical Completion, submit a schedule of the additional spare parts that the Sub-contractor recommends should be supplied over and above those consumable spares required up to Practical Completion and for routine maintenance.

Each item on the schedule shall have the manufacturer's current price inserted which shall include for packaging and delivery to site.

These additional spare parts may or may not be ordered during the currency of the Sub-Contract and therefore the costs thereof shall only be included in the Sub-Contract when the subject of a written instruction from the Project Manager / Contract Administrator.

Spare parts shall be strictly interchangeable and suitable for use in place of the corresponding part supplied with the plant. They shall be prepared by greasing and/or painting before packaging to prevent deterioration during delivery and storage.

Where spare parts are supplied by the Sub-contractor each package shall be clearly marked and numbered for identification in accordance with the schedule of spare parts and referenced to the equipment list in the Operation and Maintenance Manual.

If the Sub-contractor fails to give this information in good time and the Employer is thereby prevented from carrying out proper maintenance of the installation, the Sub-contractor will be responsible for carrying out the maintenance at their own cost. This requirement is in addition to the provision of the spares and tools detailed elsewhere in the contract.

37.2 Tools

At Practical Completion, provide two complete sets of tools and portable indicating instruments for the operation and maintenance of all plant and equipment together with suitable means of identifying, storing and securing same.

38.0 SYSTEM USED BEFORE PRACTICAL COMPLETION

Prior to practical completion of the works, the Sub-contractor may be permitted to use the permanent installation, they shall make good all defects prior to handover, including the replacement of consumable items with new components such as dirty filters, defective lamps etc, paying all charges and adapting the installation temporarily as necessary. All lamps etc shall be cleaned prior to handover.

The Sub-contractor(s) shall make due allowance within their tender for the replacement of all

luminaire lamps that fail prior to Practical Completion.

Should the period of use of the permanent installation be for a period of more than 3 months prior to practical completion then **ALL** consumable items shall be replaced with new components.

Any luminaires containing integrated or non-replaceable lamp sources (LEDs) that fail within the defects liability period shall be replaced as equal by the Sub-contractor(s) at their own expense. Any luminaire failures beyond this but within the manufacturer's warranty period shall be replaced at the manufacturer's expense including all necessary labour costs. The Sub-contractor(s) shall seek statements from the manufacturers prior to order that all labour costs for luminaire replacement shall be included as part of the warranty agreement.

The Sub-contractor shall indemnify the employer against loss, claim, or proceedings arising from their use of the permanent installation prior to the practical completion of the works.

This permission must be sought in writing and approved by the Project Manager / Contract Administrator prior to the installation being used.

39.0 CONDITION OF SITE ON COMPLETION

On completion of the Contract, the Sub-contractor shall remove from the site all tools and plant used for the execution of the Works together with all rubbish, packing cases and material and redundant material or equipment, and they shall make good or reimburse for making good any damage to buildings, roads or other parts of the site, where in the opinion of the Project Manager / Contract Administrator such damage has been caused by or is the responsibility of the Sub-contractor.

40.0 COMMISSIONING AND TESTING

40.1 General

The Sub-contractor shall notify the Main Contractor in writing when, in their opinion the works or part thereof, which the Sub-contractor is responsible, are ready for testing and commissioning.

Prior to notification the Sub-contractor shall agree procedures for notices, witnessing, reporting and recording tests with all parties involved including Local Authorities and shall make all specified tests to the satisfaction of the Project Manager / Contract Administrator.

The Sub-contractor shall then carry out the tests and then operate the installation or selected parts thereof in the presence of the Project Manager / Contract Administrator and shall make all specified tests to the satisfaction of the Project Manager / Contract Administrator.

Submit copies of the formal test certificates signed by the Works Package Contractor's representative not later than seven days after completion of successful tests.

The Sub-contractor shall carry out demonstrations of the operation of the systems to Building

Control, Fire Officer, Building Insurers and the Environmental Health Officer.

The Main Contractor will carry out the following role:

- Monitor the production of commissioning logic diagram in association with the Sub-contractor and Commissioning Specialist Sub-contractors
- Review progress on commissioning against an agreed programme. The Sub- Contractor's will be required to attend regular meeting to monitor progress and shall produce reports
- Witness commissioning and testing, including off-site testing
- Witnessing of reliability trials.

40.2 Maintenance of Permanent Plant, Equipment and System

Where the Sub-contractors are required to operate plant and systems during commissioning or as otherwise described in the Sub-Contract Documents, the Sub-contractor shall be responsible for their operation and maintenance as recommended by the manufacturers and as described in current Codes of Practice. Maintenance logs must be prepared by the Sub-contractor. Any additional costs for replacement of plant or equipment resulting from failure by the Sub-contractor to maintain or operate the plant or equipment in the correct manner, shall be borne by the Sub-contractor.

40.3 Additional Tests

Re-test or carry out at no extra cost any additional tests required to establish acceptability of the Works Package following failure of any part therefore or any item therein to meet the specified standard.

The Sub-contractor shall ensure that items raised on technical observation sheets by the Project Manager / Contract Administrator during the works shall be attended to timeously to minimise excessive defects on completion of the works.

Where excessive defects exist on completion of the works and where the Contractor has made no attempt to remedy the situation the Contractor shall incur a charge from the Client of £20.00 per hour to prepare a comprehensive defects list.

40.4 Instrument and Equipment for Testing

Supply, check, recalibrate whenever necessary and maintain in good working order all instruments and equipment for setting out, measurements, gauging, inspection, commissioning and performance testing whether they are specifically called for or implied by the Sub-Contract Documents.

All such instruments and equipment shall be adequate for the purpose and shall satisfy the purposes and accuracies required by the Sub-Contract Documents.

All instruments and equipment shall remain the property of the Sub-contractor.

40.5 Provision of Staff

Provide all necessary staff with the relevant skills and competence for all inspection, testing, commissioning and performance testing and provide suitable evidence to prove competence prior to their appointment.

41.0 OPERATION/MAINTENANCE OF THE FINISHED BUILDING

41.1 Handover Documentation

Handover documentation including commissioning data, operating and maintenance manuals, and record drawings to be prepared using Microsoft Windows based systems.

41.2 CAD Record Drawings

CAD Record Drawings of the complete installation shall be provided by the Contractor on completion of the works. The issue of these drawings is a pre-requisite of practical completion of the works and the certificate will not be issued until the Project Manager / Contract Administrator is satisfied that the following criteria has been achieved.

The system for production of drawings shall be AutoCAD.

Record drawings of the final "as installed" layouts shall be issued in draft form for approval prior to the testing and commissioning period to allow checking for accuracy. Once complete the set of draft record drawings shall be revised as necessary to incorporate testing and commissioning data where applicable, and the final set(s) of record drawings shall be handed over in accordance with the Main Contract preliminaries.

The Sub-contractor shall issue at a time in accordance with the main contract preliminaries the complete approved package of record drawings made up of 1 set of white prints and 1 electronic copy on CD.

The Sub Contactor shall maintain on site a set of drawings for the purpose of progressive marking up of alterations and variations. These drawings which shall form the basis of the record drawings shall be available for inspection by the Project Manager / Contract Administrator any time.

If, in the event, upon completion of the works, of it being discovered that, the Sub-contractor shall have failed to comply with this requirement and it becomes necessary for the Main Contractor to examine or trace through installed service in order to update the "as installed" drawings, the cost of this work will be time charged and debited to the retention monies being held on the Contract.

A set of draft marked up white prints shall be issued 8 weeks prior to Completion or Completion of Section as defined in the Main Contract Preliminaries for the Project Manager / Contract Administrators comments. The Project Manager / Contract Administrator shall provide such comments within 2 weeks of receipt of the drawings.

The "records" drawings shall indicate the completed work as installed all as follows:

- The location, including level if buried, of Public Authority supplies provided within the Sub-Contract, whether carried out by the Sub-contractor or by the appropriate Authority together with the points of origin and termination, size and materials of pipes, line pressure and/or other relevant information
- The layout, location and extent of all piped services showing pipe sizes throughout, together with all valves for regulation, isolation and other purposes, shown numbered in accordance with the actual installation
- The layout, location and extent of all air ducts, including those formed in builders work or otherwise outside this Sub-Contract by forming part of the system, showing all dampers and other equipment, acoustic attenuators, grilles, diffusers or other terminal components. Each duct and each terminal component shall be marked with its size and the air quantity flowing, as actually measured after approved regulation of the system or as computed by the addition of such measured quantities
- Single line and schematic wiring diagrams for the whole of the Sub-Contract works showing all terminal and cable sizes
- The layout, location and extent of all electrical plant, cable, cable tray, cable trunking, conduit, distribution boards, switches, outlets and lighting fittings which form part of the Sub-Contract works including dimensioned layouts of all concealed work. Where components are grouped or housed in a cubicle or on a common panel, and exploded arrangement must be incorporated
- The layout, location and extent of all electrical plant, cable, cable tray, cable trunking, conduit, switches, outlets, terminals and indicators and alarms of all ancillary communication, detection, alarm and control installation which form part of the Sub-Contract works, including dimensioned layouts of all concealed work
- The location and identity of each room of space housing plant, machinery, distribution boards, draw-in boxes or apparatus
- The detailed general arrangements, to one-twentieth scale, of all boiler house, machinery spaces, air handling plant, tank rooms, switch rooms, meter rooms and other plant spaces including the location, identity, size, colour coding and details of each piece of plant and equipment
- The detailed general arrangements, to one-twentieth scale of service subways, ducts, meter rooms or other special sections of the work where, in the opinion of the Design Team, the small scale drawings cannot provide an adequate record
- Manufacturer's drawings showing the general arrangement and operation of component parts of all machines and any pieces of equipment which may require servicing
- Flow diagrams indicating the principles of the arrangement and operation of each of the various services as related to central plant, other principal components and zoning of distribution etc

- Diagrams illustrating the principles of automatic controls and of instruments, presented in combination with the foregoing or separately, as agreed with the Design Team
- Location of all earth tapes, earth electrodes and test points
- In conjunction with schedules of location and detail and reference, voltage and wattage of all lighting fittings
- Comprehensive electrical diagrams or sets of diagrams which shall show:
- Size, type and length (to within one metre) of each main and sub-main cable, together with the measured conductor and earth continuity resistance of each
- Manufacturer's internal wiring diagrams for each piece of electrical equipment supplied under the Sub-Contract, together with physical arrangement drawings to locate and identify the component parts
- Comprehensive diagrams showing in detail all power wiring and all control wiring and/or pneumatic of other control piping executed with the Sub-Contract by others in accordance with detail provided by the Sub-contractor, including size and type of conductor or piping used and identifying the terminal points of each.

The drawings shall conform to the following standards:

- All hard copy drawings shall be on best quality transparent film
- All lettering shall be in ink with all titles, heading etc, stencilled in height not less than 5mm
- All other lettering shall be stencilled, upper case in height of not less than 3mm.

Each drawing shall show the following information:

- Employer's name
- Name of Contract and, where appropriate, the zone or floor designation
- Description of drawing number and scale
- Name and address of originator.

The completed drawings shall be signed as true record drawings and shall be submitted at the same time as the Operating and Maintenance Instruction Manuals for comment.

The Sub-contractor should note that in the event of non-compliance with this Clause, the Project Manager / Contract Administrator reserves the right to have prepared the necessary drawings and to deduct the cost of preparing same from monies otherwise due to the Sub-contractor. The sum deducted will be the actual cost and may be greater than any sum declared by the Sub-contractor.

41.2 Plantroom Schedules and Schematics

In addition to the provision of record drawings, the following drawings shall be hung under glass in each plantroom and any other appropriate location:

- Circuit diagrams consisting of schematic drawings of circuit layouts showing identification

and duties of equipment, numbers and locations, control and circuits

- Valve schedules in the form of typewritten sheets showing the number, type, location, application/service and symbol, and normal operation positions of each valve installed
- Control schematics
- Mechanical and electrical plant items
- First aid instructions for treatment of person after electric shock
- All other items required under Statutory or other regulations
- Location of main incoming gas valve serving gas meter
- Emergency operating procedures and telephone number for emergency call out service applicable to any system or item of plant.

41.3 Operating and Maintenance Instruction Manuals

The Sub-contractor is to understand that this issue of the manuals is a pre-requisite of practical completion of the works and the certificate will not be issued until the Project Manager / Contract Administrator is satisfied that the following criteria has been achieved.

41.3.1 General

A full technical description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.

A technical description of the mode of operation of all systems.

Clear and comprehensive instructions for the starting up, running and shut-down of each system or apparatus.

Instructions in respect of any precautionary measure from time to time necessary (eg. against freezing or corrosion).

Instructions in respect of the care of apparatus normally subject to seasonal use.

Instructions, as to the nature, extent and frequency of servicing necessary properly to maintain the Works in good condition and as to the materials to be used for the purpose. This information may be supported in detail, but not replaced by, maintenance instructions provided by the Suppliers of particular component apparatus.

The names and addresses of suppliers of all major components of the works as may potentially be required to obtain spare parts or replacements.

Detailed testing and commissioning records.

Emergency measures including telephone numbers of the Sub-contractor's maintenance staff

and names and addresses and telephone numbers of all manufacturers and suppliers.

Copies of manufacturer's data with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data, in the form of individual booklets and the like, shall be indexed and cross referenced to the operating and maintenance instructions and presented, suitably protected, in box files or folder.

The location and identity of each room or space housing plant, machinery or apparatus.

Drawings, or sets of drawings, to a scale as directed showing the following as installed:

The detailed general arrangement of all plantrooms, all electrical intake and switchgear rooms, machinery spaces, air handling plants, tank rooms and/or other plant or apparatus, including the location, identity, size and details of each piece of apparatus. The information with respect to size and details may be presented in schedule form subject to the prior approval of the Engineer.

The detailed general arrangement of service ducts, risers, meter rooms or other special sections of the works, where in the opinion of the Project Manager / Contract Administrator, the scale of "approved for construction" drawings cannot provide an adequate record.

Manufacturers' drawings showing the general arrangement and assembly of component parts of all machines and any piece of equipment which may require servicing.

Schematic and wiring diagrams of all main and sub-main distribution systems to include motive power and control function within the Sub-Contract and typed circuit charts for all fuse and circuit breaker distribution boards.

Manufacturer's internal wiring diagrams for each piece of electrical equipment supplied under the Sub Contract, together with physical arrangement drawings where necessary to locate and identify the component parts.

Comprehensive diagrams showing in detail wiring and all control wiring carried within the Sub-Contract or by others in accordance with details provided by the Sub-contractor, including size, and type of conductor used and identifying the terminal points and reference of each.

41.3.2 Installation Record

- A photo reduction of all record drawings to A3 size together with an index
- Diagrammatic drawings of each system indicating principle items of plant, equipment, valves, etc.
- Legend for all colour-coded services
- Schedule of plant, equipment, valves, etc, by system, stating their locations within the building, duties and performance figures
- Each item of plant, equipment, valves, etc, installed shall have a unique code number cross referenced to the record and diagrammatic drawings and schedules. The name, address and telephone number of the manufacturer of every item of equipment and plant shall be listed together with catalogue list numbers

- Manufacturer's literature including detailed drawings, electrical circuit details, and printed operating and maintenance instructions for all items of plant and equipment supplied under the Sub-Contract
- A copy of all Test Certifications including those for all plant, equipment, valves, etc, used in the installations, including (but not limited to) electrical circuit tests, start and commissioning test
- A copy of all manufacturers' guarantees.

41.3.3 System Operation

- Starting up, operating and shutting down instructions for all equipment and systems installed
- Control sequences for all systems installed
- Schedule details of all equipment settings, and actual values maintained in controlled variables during commissioning
- Procedures for seasonal changeovers.

41.3.4 Maintenance

- Detailed recommendations as to the preventative maintenance frequency and procedure which should be adopted by the Employer to ensure the most efficient operation of the system
- Lubrication schedules for all lubricated items of plant and equipment
- A list of normal consumable items
- A list of recommended "running spares" required, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date.
- Procedures for fault finding
- Emergency procedures.

41.3.5 Number of Copies Required

The Service Sub-contractors shall provide the Main Contractor with 1 draft copy and 1 final copy of the Operation and Maintenance Manuals. In addition to the hard copies, an electronic copy on CD-Rom shall also be provided.

41.3.6 Obligations of Manufacturers to Provide Literature

The requirements and obligations of manufacturers to provide literature as part of the

installation record shall form part of plant and equipment orders and such orders shall be considered unfulfilled until literature requirements have been met.

41.3.7 Preparation of Manuals

The manuals shall be encased in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover-titled. Drawings larger than A4 shall be folded and accommodated in the binder so that they may be unfolded without being in any way detached from the rings.

Prepare the Operation and Maintenance Manuals in draft as soon as the Installation Drawings are in hand.

Make one temporary manual with provisional record drawings and preliminary performance data available at commencement of commissioning to enable Employer's staff to familiarise themselves with the installation. These should be of the same format as the final manuals with temporary insertions for items which cannot be finalised until the Sub-Contract is commissioned and performance tested.

The cover shall be printed with the following information:

"Operating and Maintenance Instruction Manual" (Project Name and Service

Where more than one volume is required, the cover shall also be printed with volume number.

Each section of the manual shall be divided by a stiff divider of the same size as the holder.

The divider shall be labelled as to the section of the manual which is following.

All written instructions within the manual shall be typewritten with a margin on the left-hand side.

The arrangement of the manual shall be as follows:

Section One Index

Section Two Description of the Design Intent

Section Three Description of the operational routines. The description must include step by step instructions on starting and stopping each plant or system and a fault diagnosis procedure in diagrammatic and tabular form to show the action necessary to correctly identify defective pieces of equipment and the steps to be taken to rectify faults.

Section Four Planned maintenance instruction. This section must include step by step instruction on the maintenance of all items of plant. Data shall also be provided for ordering replacements. Full sets of manufacturer's maintenance instructions including wiring diagrams, cable schedules, circuit chart. Protection and overload relay settings shall be recorded and calibration charts shall be incorporated. This section shall include a set of drawings for the installation

upon which is recorded all plant settings, water flow-rates, pump heads and noise level readings as adjusted and measured during the testing commissioning period.

Section Five A set of record drawings and Test Certificates. If necessary, due to the number of drawings which have to be included in the manual, each drawing shall be photographically reduced in size to suit the manual.

Section Six Emergency measures including telephone numbers of the Sub-contractor's emergency staff, names, addresses and telephone numbers of all manufacturers.

41.3.8 Submission of Operation and Maintenance Manuals

The final draft of the Operation and Maintenance Manuals shall be submitted in due time, and in any case not less than two weeks prior to Practical Completion, so that at least one copy of the complete final version is in the possession of the Employer at Practical Completion in order to comply with the Health and Safety at Work Act.

If partial possession is required by the Employer then the documentation shall also be phased accordingly and so arranged to finally form one comprehensive document.

It shall be the Sub-contractor's responsibility, whenever a successive phase of the Sub-Contract is handed over, to amend and update the previously issued version of the Operation and Maintenance Manuals, bring it to the appropriate stage of completion and submit same to the Main Contractor in due time to comply with the Health and Safety at Work Act.

42.0 INSTRUCTIONS OF EMPLOYER'S REPRESENTATIVE

The Sub-contractor shall, at a time to be agreed prior to Completion as defined in the Main Contract Preliminaries, instruct the Employer's representative in the use and correct operation of the Contract works and shall satisfy himself that such staff are capable of taking over the installation. During this period of instruction, the Sub-contractor shall be responsible for the correct operation and maintenance of the installation.

The training shall take place prior to completion and during the 14-day system reliability trial with all systems fully operational. The Sub-contractor shall allow for a minimum of seven days training for three representatives. All three representative will attend each day of training. The Sub-contractor shall provide training handout notes and background information to the Employer's representative prior to the training period.

Training shall be structured to suit all the relevant building elements (Building and its Services) and shall include theory, demonstration and hand-on experience in the operation and maintenance of the building. Each training day shall allow for relevant instruction on an elemental basis.

Theoretical training shall be carried out in a suitable quiet room with all necessary visual aids and facilities. A register shall be kept of attendance at each of the training sessions and a certificate shall be issued to all attendees at the end of each training session.

All training sessions shall be video recorded by the Services Sub-contractor and two copies shall be provided to the Employer's Representative prior to handover.

43.0 SYSTEM RELIABILITY TRIALS

Upon completion of the commissioning and prior to Practical Completion a system reliability trial will commence immediately. This trial shall run continuously for a period of 14 days during which time the responsible Sub-contractors shall be in regular attendance to carry out temperature and other recordings of the installations performance without adjustment to the equipment of installation in any way, without the prior sanction of the Project Manager / Contract Administrator.

During the period of the Trial for the Services Installation the Sub-contractor shall simulate system loads to ensure the system is checked under load.

The load shall be varied to ensure the rate of system response and the accuracy of setpoints calibration is checked for all sensors and equipment.

During the period of the trial no repairs other than that classified as normal maintenance shall be carried out. Should in the judgement of the Design Team, it become apparent that plant requires substantial repairs or adjustments, then the trial will be re-started on completion of such repairs or adjustments.

With respect to defects, the following conditions shall apply:

- Should the replacement, renewal or remedial measures necessary during the defects liability period affect the efficiency or proper operation of the Works or any portion thereof, the Project Manager / Contract Administrator may call for further tests to be carried out to demonstrate that the installation is working satisfactorily.
- If, as part of their liability for defects, the appropriate Sub-contractor replaces or renews any portion of the Works, the Defects Liability period for any such portion of the Works will be deemed to commence from the date of such replacement or renewal.
- Should the appropriate Sub-contractor fail to remedy any fault or defect within a reasonable period of time of its being reported, then the Main Contractor may proceed to undertake the remedial action utilising another person or firm. In such a situation, the remedial work carried out will be at the risk and expense of the Sub-contractor in default.

44.0 SYSTEM RELIABILITY CHECKS

The Sub-contractor shall attend site twice within the ensuing twelve months from Practical Completion to demonstrate to the Client the satisfactory operation of the installed system at the extremes of their operating conditions. During these test should it become apparent that the plant requires substantial adjustments to meet the specified criteria, then once these adjustments are complete the Sub-contractor shall be required to repeat the demonstration.

Temperature and other recordings of the installations performance shall be collated and bound into the Operation and Maintenance Manuals.

Should the tests fail to demonstrate that the plant and equipment are properly installed and functioning correctly, the cause of the failure shall be investigated and should this be due to incorrect or faulty work by the Sub-contractor or their Sub-contractor's or suppliers, then the Sub-contractor shall without delay, carry out such remedial measures and adjustments as may be necessary and repeat the commissioning and testing procedure to the satisfaction of the Project Manager / Contract Administrator.

Where it is not possible at the particular time of commissioning and testing for full load conditions to be obtained or simulated, the Sub-contractor shall repeat such operations of full load or simulation thereof at a time when this can be achieved.

For the purposes of commissioning and testing of the installation the Sub Contractor shall provide all necessary skilled and unskilled labour and all necessary instruments and testing equipment.

45.0 PRACTICAL COMPLETION

Practical Completion of the scheme shall be granted when: all contract works are complete; all services are installed and have been satisfactorily commissioned; all approved "as built" working drawings and operation and maintenance manuals of the building and services have been presented to the Client; the Client's Building Manager and their staff have been given sufficient training on the management of the services; all tools and spare parts specified in the contract have been delivered to site.

46.0 OBLIGATIONS AFTER PRACTICAL COMPLETION

Between the issue of a Certificate of Practical Completion and the Certificate of Making Good Defects relating to the whole or part of the Sub-Contract Works, provide the following:

- A prompt call-back service, available at all times, to attend to any faults
- Defects, shrinkages or other faults appearing at any time during the Defects Liability Period which have let, or, in the opinion of the Project Manager / Contract Administrator, are likely to lead to failure or malfunction of any part of the Contract shall be made good immediately upon receipt of any written instruction from the Project Manager / Contract Administrator
- Prepare and submit a record of any failure or malfunction of any part of the Sub-Contract, the remedial action taken, subsequent re-testing and the results thereof
- Notify the Project Manager / Contract Administrator of any malfunction in, or damage to, the Sub-Contract which the Sub-contractor can demonstrate had been caused by incorrect operation of the system, vandalism or action of a third party
- Inform the Main Contractor in writing when all defects are finally rectified so that an inspection may be carried out by the Project Manager / Contract Administrator prior to the

issue of the Final Certificate

- Carry out a final test at the end of the Defects Liability Period to demonstrate to the Project Manager / Contract Administrator that the Sub-Contract works are operating efficiently and that all components are functioning correctly
- Carry out all work using competent, trained personnel and except where made necessary by abuse, misuse or negligence by other than the Sub-contractor, make no charge to the Employer.

47.0 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

All BMS products must comply with EMC Directive (89/336/EEC, Statutory Instrument No. 2372).

The generic standard will be displaced by product-specific standards as and when they are introduced. CEN Technical Committee, TC247, "Controls for Mechanical Building Services is currently written on EMC Immunity Specification specifically for BMS" (CEN/TC247/WG3).

Compliant equipment is required to carry the CEN mark.

Control panels should be tested for compliance with the EMC Standard BS EN 60439-1 : Part 1. The panels should be CE marked. The panel shall be tested by a competent third party for compliance.

48.0 PLATFORMS AND WALKWAYS

Where necessary galvanised mild steel platforms and walkways shall be supplied and installed by the Sub-contractor. These shall be provided to ensure all plant can be easily maintained and to provide protection to pipework and ductwork, particularly along notional access routes/paths.

The platforms and walkways shall be finished to match their location and shall be securely fixed in position.

49.0 SOFTWARE COPYRIGHT LICENCE

The Client shall be granted copyright licence for software packages that are customised for the control of equipment or services that serve this project. This shall include software packages covering water management, air handling, security lighting, heating, air conditioning and maintenance.