

**Mechanical and Electrical  
Employers Requirements**

**Project Name: Mundesley Hostel - Heating Refurbishment**

**Location:- Mundesley – Hugh Town St Marys IOS**

**Client:- Council of the Isles of Scilly  
Date:- May 2016**



## PROJECT TEAM

Client	Council of the Isles of Scilly The Town Hall Hugh Town St Marys Scillonia
Project Manager	Council of the Isles of Scilly The Town Hall Hugh Town St Marys Scillonia
Architect	
Quantity Surveyor	
Structural Engineer	
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Revision	Date	Author	Comments
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2			
3			
4			

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## PRELIMINARIES AND GENERAL CONDITIONS

### 1.1 GENERAL

This brief description of contract conditions is issued for the guidance of the Mechanical and Electrical engineering services Tenderers only. It is not intended to give full details of the contract preliminaries and conditions of contract, these shall be established by the Tenderer from the Main Contractor/ Employer.

The contract is intended to be **design and construct** based on these Employers Requirements, room data provided on the drawings and any supporting M+E Scope of Works drawings/layouts. There will be a significant level of input from the Consultants appointed by the Client as both concept designers and technical advisors. However the main works will be Contractor designed and subject to review by the Consultants.

The Mechanical and Electrical Contractor(s) shall be deemed to have included for all Design, installation, materials and workmanship (including commissioning) to complete and set working the whole of the works in accordance with the Employers requirements, Room Data Sheets and scope of works, and to the reasonable satisfaction of the Contract Administrator/Consulting Engineer.

There may be elements of the works that will require specialists design input that are not fully detailed and will require the contractor to appoint a suitable specialist to prepare a design and submit relevant proposals to meet the requirements. All new works will be carried out with the full agreement of the Consultants and designed in consultation with them.

The Contractor or his appointed designer shall be responsible for all aspects of the scheme design and its implementation and shall hold suitable levels of Professional Indemnity cover for such design works which shall be maintained for 12 years from completion of the project.

The Client may require a Collateral Warranty from any Designer and the Contractor and these shall not be unreasonably withheld.

Mechanical and Electrical work will be carried out by the Mechanical and Electrical Contractor (s) appointed by the Main Contractor. In any event Electrical Contractors shall be as a minimum NICEIC registered or equal and preferably also a member of the ECA. Similarly, Mechanical Contractors shall be HVCA or equal registered.

Builder's work associated with the Mechanical and Electrical work, i.e. cutting of holes and chases, making good etc., will form part of the Contract and will in general be carried out by the main contractor.

Electricity for small power tools (110V) will be made available on site.

The word Mechanical/Electrical "Contractor" hereinafter shall mean "Main contractor".

The definitions of terms used in this document are listed in the Section A Appendix A "Definitions".

The successful Tenderer shall be the Main Contractor under the terms and conditions of the Conditions of Contract.

The Conditions of Contract are given in the Section A Appendix B " The Contract".

### 1.2 VISIT TO SITE

The Mechanical/Electrical Contractor shall visit site to ensure that he is fully conversant with the site and its conditions and in tendering will be deemed to have done so. This shall be by prior appointment only and all costs associated with such a visit shall be at the Contractors expense.

The Mechanical/Electrical Contractor shall be deemed to have satisfied himself of all site conditions, failure to do so will not be considered the basis of a claim.

### **1.3 PROGRAMME / PHASING**

The Mechanical/Electrical Contractor shall work to a programme agreed with the Client and must be prepared to carry out the installation of engineering services when requested.

The programming of the works will be a high priority as it is intended to carry out the majority of the works during holiday time due to the nature of the contract and the requirements of the hostel.

The services and systems will be designed specifically to allow installation in accordance with a programme of works already agreed with the Client. The details of this programme will be made available to the contractors as part of the main contract tender documentation.

There may be some requirement for out of hours working where items such as pipe/cable runs must cross main access routes etc used by the Hostel in normal day to day operations or link into other areas of the Hostel that remain in operation.

It shall not be permitted for works to be carried out whilst the Hostel is in operation that has any impact upon these main access routes or affects any safe escape routes from the building. The contractor shall make appropriate allowance for out of hours working.

### **1.4 BUILDING /OTHER WORKS**

The contractor is advised that as this is a refurbishment contract, there will be other works ongoing at the same time as the works to the M+E services. This may include upgrades to Building Fabric etc as well as some redecoration works.

The contractors shall coordinate such that these works do not impact upon each other to the detriment of the project. A full schedule of the building works will be indicated on the Contractors project programme.

### **1.5 MATERIALS**

Quality materials shall be used throughout with due consideration to longevity and maintenance. Consideration shall also be given to compatibility with other services and systems on site to minimise the amount of spares required to be held on site.

Any goods or materials which may be on extended delivery and thus affect the above programme shall be noted by the Mechanical/Electrical Contractor when returning his Tender.

### **1.6 DISCREPANCIES**

If the Mechanical/Electrical Contractor notes any discrepancies, omissions, or items regarded as at variance with good practice, then he shall refer to this before returning his tender.

Any discrepancies between or within the drawings and Employers Requirements shall be brought to the attention of the Client by contacting [MHR@Scilly.gov.uk](mailto:MHR@Scilly.gov.uk) in the first instance. The Council will respond to all parties following consultation. In the event of a discrepancy being discovered after the time of tendering or being unresolved at tender stage the alternative having the greater cost shall be deemed to have been included in the tender.

No claim for extra costs will be considered in respect of any item shown on the drawings only or in the specifications only as these documents are deemed to be complimentary and shall be read and understood together.

## **1.7 EQUAL AND APPROVED**

All items of plant, equipment and materials named in this specification by manufacturer, distributor and or by figure number or index number etc, are intended to impart the design criteria and the implied standard of plant and materials construction and performance to be used for the building of the systems as specified and drawn.

Where an alternative is being offered as an equal for approval, the Mechanical/Electrical Contractor shall in all respects provide tabulated data for the specified item and the offered alternative selection, detailing at minimum component part construction and materials used, the British Standards and Codes of Practice covering the manufacture, materials and grades, construction and tests where applicable, this shall also include motors and drives. The Mechanical/Electrical Contractor is to provide tabulated proof of equal performance, rating and efficiency, all measured against the same base criteria. Manufacturers catalogue data sheets shall be provided highlighted where necessary to show equality.

Unless all of the above information is freely and efficiently provided, alternatives will not be considered. In short, the Mechanical/Electrical Contractor shall prove equality.

The Consulting Engineer shall only approve the offered alternative thereafter.

Only after approval from the Consulting Engineer can the Mechanical/Electrical Contractor install the offered alternative.

## **1.8 COORDINATION**

The Mechanical/Electrical Contractor shall coordinate closely with all other trades to ensure that work progresses smoothly and that there is full co-ordination of all services. Coordination drawings and other working documents shall be produced upon request.

In the event of work having to be taken down and re-done due to lack of foresight/communication between the Mechanical/Electrical Contractor and any other trades, then this will be at the Mechanical/Electrical Contractors' own expense, together with the cost of correcting these errors.

## **1.9 CONTRACT DRAWINGS**

This Employers Requirements document shall be read in conjunction with the following drawings where provided:

- Mechanical Services layouts or Scopes of Works drawings
- Electrical Services layouts or Scopes of Works drawings

Drawings shall only be used for their intended purposes i.e. Services drawings shall not be used for building or other matters.

Layouts of rooms, doors, equipment etc. shall be assumed correct for tender purposes, but it shall be the Mechanical/Electrical Contractors' responsibility to check final positions.

The Mechanical/Electrical Contractor will be responsible for setting out the installation and shall check the positions of all apparatus and service routing relative to other equipment, furniture, door swings, fixtures, fitments, building structures and fabrics, window heights, widths and sill heights, etc., before installation.

## 1.10 DESIGN AND WORKING DRAWINGS

The contractor is advised that he shall produce coordinated design and working drawings at the outset of the project and that these shall be submitted to the Consultants in good time to enable comment to be made prior to commencement of installation works.

All contractor designs shall be offered to the Consultant for review and a period of 10 working days allowed for such review to take place.

The contractors drawings will, following review be given a status as follows:-

- A= Accepted and suitable for Construction
- B= Accepted with Comments.
- C= Not acceptable

Only drawings of status A shall be used for construction.

All drawings shall be supported with appropriate calculations and other items necessary to prove compliance with the Employers Requirements and Room Loading details.

He shall produce coordinated drawings of congested areas and shall demonstrate that his proposals for equipment and systems to comply with the Employers Requirements can be installed within the available space.

Upon completion, the contractors shall produce all required "as fitted" drawings as defined within this specification. These shall be included within the Operation and Maintenance Manuals.

The contractor is advised that failure to produce all required documentation at handover will result in delay to the payment of final accounts.

The contractor is advised to carry out a site visit prior to tendering for the works. The Client shall not be financially responsible for any items that could have been foreseen if this condition had been complied with.

Any site visit shall be by arrangement with the Council by contacting [MHR@scilly.gov.uk](mailto:MHR@scilly.gov.uk) in the first instance.

The electrical contractor shall liaise with the mechanical contractor and other trades to ensure all required coordination of services in both design and implementation is carried out prior to commencement of the installation.

The contractor shall advise the consultants in good time of contractor specified items and shall offer these full details of these items for approval by the Consultant. The contractor shall allow 10 working days for such approvals to be given.

The contractor shall take responsibility for ensuring that all items can be installed within the available space.

The Contractor shall supply all equipment, materials, tools, labour and all necessary items for the complete supply, delivery, off-loading, location, installation, connection, testing and commissioning of the installation in accordance with the specification and drawings and to the complete satisfaction of the Consulting Engineers.

The Employers Requirements shall be read in conjunction with the Room Loading and Scoping Drawings as prepared by the Consulting Engineers and the Tenderer may obtain any further details he may require for the purpose of tendering from the Council by contacting [mhr@scilly.gov.uk](mailto:mhr@scilly.gov.uk)

In the event of there being a variation between the drawings and ER's, the Council and Consulting Engineers will decide the matter and no extra will be allowed. The drawings and ER Document shall be deemed to be complementary each to the other and any item shown on the drawings but not described in the specification and vice-versa shall be deemed to be included.

Any Services drawings provided as part of the tender package are intended to indicate the extent of the installations and the locations of points and are not intended as a working drawing.

All containment, pipework and ductwork etc., shall be fixed in the neatest possible manner employing all the fixings, fittings or sets to accomplish this to the entire satisfaction of the Consulting Engineers and work condemned on this account shall be removed and replaced without additional cost.

At the time of tendering any proposed departure from the ER Document and drawings shall be clearly stated, and any comments with regard to the efficacy of the design, availability of materials and time to complete the work shall be made.

In general this section of the Employers Requirements is complementary to the other sections.

However in the event of any apparent contradiction, the requirements as stated hereinafter shall be taken as correct.

The Mechanical/Electrical Contractor shall include in his tender for the preparation of working drawings. These shall be detailed to show all major elements, the scale and detail of which shall be to the satisfaction of the Consulting Engineer/Contract Administrator.

Four copies of all drawings are to be submitted for comment and re-submitted as necessary to include such comments prior to any works being commenced.

The precise requirement for working drawings will be at the discretion of the Consulting Engineer / Contract Administrator.

#### **1.11 SCHEDULE OF RATES**

The Mechanical/Electrical Contractor shall provide a fully itemised and quantified Schedule of Rates. This shall be within seven days of receiving the request from the Contract Administrator/Consulting Engineer.

The schedule shall detail the rates of all components used. The rate of each item shall be inclusive of all associated costs including labour, materials, overheads, profit and attendance, but exclusive of VAT.

The schedule shall summate individually and totally to the values given in the Tender Summary form submitted at tender stage.

#### **1.12 SUB LETTING**

The Mechanical/Electrical Contractor will not be permitted to sub-let any part of the work unless specifically permitted by the ER's or unless he has received written consent from the Contract Administrator/Consulting Engineer.

Exceptions to this may be any specialist services such as but not limited to, alarms, data and communications, BMS and CCTV where specialists may be used and sub-contracted to the M+E contractor. These specialists shall work under the direction of the M+E contractor who shall be responsible at all times for their conduct on site, compliance with programme and delivery of the scheme to satisfy the performance specification.



### **1.13 QUOTATIONS**

No suppliers or other parties have been contacted in advance of tender and it is the Contractors responsibility to obtain all necessary quotations for specialist elements of the works and to include those within his tender package.

### **1.14 DEFECTS LIABILITY PERIOD AND MAINTENANCE**

The Mechanical/Electrical Contractor will be totally responsible for attending to all defects to the installation that may occur during the whole of the Defects Liability Period of twelve months from date of handover or any other period detailed elsewhere within the Contract documents.

In addition, he shall maintain the systems in accordance with the manufacturers requirements for this 12 month period.

After this 12 month period, the plant and systems will be maintained by the Schools Term Maintenance Contractor.

Such maintenance shall be in accordance with any relevant B.S. (i.e. BS5839 for Fire Alarm Installations), HVCA or CIBSE document.

This does not relieve the D+B contractor of his contractual responsibilities with respect to defects liability during the 12 months post handover.

A report shall be provided following each visit detailing any comments/action taken. A copy of the report shall be forwarded to the Consulting Engineer and to the Employer.

### **1.15 SITE MANAGEMENT**

The Mechanical/Electrical Contractor shall appoint the following key personnel for the duration of the works.

- .1 An on-site foreman who shall co-ordinate all the proposed works and supervise all specialist sub-contractors. The on-site foreman shall also liaise closely with the Client or representative, particularly in respect of modifications to existing services.
- .2 A senior project manager who shall deal with all other matters pertaining to the works and who shall visit site on a regular basis and shall be the main point of contact for all contractual matters between the M+E contractor and the Client team.

### **1.16 SITE ACCOMMODATION**

The Mechanical/Electrical Contractor is to provide all accommodation necessary for the proper protection and progress of works.

Liaison with the Council upon appointment may lead to some provision of facilities within the Boarding House such as WC's and a Break Room.

Any office or storage accommodation and workshops may have to be relocated during the progress of the works and the Mechanical/Electrical Contractor shall allow for disturbance thereby incurred.

#### **1.17 RECORD DRAWINGS**

The Mechanical/Electrical Contractor shall provide "as installed" record drawings showing the full extent and accurate details of the installed positions of engineering services.

The record drawings shall show positions, runs, sizes and types of equipment, ductwork, trunking, cables, pipework etc.

Complete record drawings shall be provided as follows:

- 1      2 sets of prints on paper.
- 2      1 CAD set in Autocad .dwg and Adobe PDF format on CD.

The Mechanical/Electrical Contractor shall hand over the record drawings to the Employer at time of completion. Failure to do so will prohibit the issue of a Practical Completion Certificate for the works and will delay payment of final accounts.

A draft set of the drawings is to be provided to the Consulting Engineer/Contract Administrator for approval before completion.

#### **1.18 OPERATION AND MAINTENANCE MANUALS**

The Mechanical/Electrical Contractor shall provide operating and maintenance manuals for all the equipment provided.

The manuals shall contain manufacturers literature, method of operation, extent of maintenance and servicing required, list of spares, test certificates, commissioning reports, etc.

The format of the manuals shall be agreed before submitting for approval.

The manuals shall include the following:

- .1      General and technical description giving function and manner of operation of each system.
- .2      Instructions for starting up, operating and shutting down of each system, including any emergency/safety routines.
- .3      Schedule of equipment supplied showing details of make, model type, serial number, and name plate data.
- .4      List of manufacturers names, addresses, telephone and fax numbers for all major items of equipment.
- .5      Manufacturers general catalogue and installation/maintenance instructions for all items of equipment.
- .6      Schedule of recommended spares and lubricants for all equipment.
- .7      Schedule of maintenance requirements on a daily/weekly/monthly/annual basis.
- .8      Data on general setting of controls and monitoring instruments of each system.
- .9      Fault finding routines.
- .10     Information relating to Health and Safety.
- .11     Copies of valve charts, schematics, wiring and control diagrams, copies of commissioning/test records and certificates.
- .12     List of record drawings.
- .13     All test and commissioning results for all systems

- .14 All “as fitted” drawings

The complete manuals shall be provided as follows:

- .1 2 copies bound into A4 ring binders.
- .2 2 copies on CD Rom

Drafts of the manuals shall be submitted for approval no less than 1 week before handover to enable them to be reviewed and commented upon.

The Mechanical/Electrical Contractor shall hand over the final set of manuals to the Employer at time of completion. Failure to do so will prohibit the issue of a Practical Completion Certificate for the works. A draft copy of the manuals is to be provided to the Consulting Engineer/Contract Administrator for approval before completion.

The Mechanical / Electrical Contractor shall also provide a Building Log Book in accordance with Building Regulations Part L2.

The Building Log Book shall be to CIBSE guidance and be in addition to the operating and maintenance manuals.

#### **1.19 DISRUPTION OF EXISTING ENGINEERING SERVICES**

The contractor shall note that this is an operational Hostel and parts may be in use throughout the duration of the contract.

There are also works to separate the heating and hot water serving the two rear apartments. the

The Mechanical/Electrical Contractor will therefore be responsible for careful programming and phasing of the work in order to minimise disruption.

Any operation that involves any interruption to existing services and/or disrupts the Employer's operations must be carried out at times to be agreed and a minimum of 5 days prior notice is to be given to the Contract Administrator unless otherwise agreed. Such notice is to be given in writing in the form of a method statement detailing the works to be undertaken and the proposed timescale. Any such operation will normally be required to be carried out outside of normal working hours.

#### **1.20 REMOVAL OF EXISTING**

All engineering services made redundant by the alterations are to be removed in entirety by the Mechanical/Electrical Contractor, unless otherwise stated.

All redundant materials and equipment thought to be reusable shall first be offered to the Contract Administrator for re-use by the Employer and if not required by them shall be removed from site by the Mechanical/Electrical Contractor and disposed of at an approved disposal site and record of such disposal held on the Health and Safety file.

Where there are Island specific restrictions on disposal of certain wastes, the contractor shall allow for removal and disposal off island.

#### **1.21 SUSPENSION AND FIXING OF ENGINEERING SERVICES**

All engineering services shall be deemed to have independent threaded rod or wire suspensions. This shall include services mounted below suspended ceilings unless specifically indicated otherwise.

#### **1.22 THE CONSTRUCTION DESIGN AND MANAGEMENT REGULATIONS**

The Construction (Design & Management) Regulations and associated Code of Practice shall be incorporated in this Contract.

The Mechanical/Electrical Contractor shall allow for complete compliance with the Regulations within his Tender.

The M&E contractor will be expected to carry out the duties of the Principal Contractor (where more than one contractor is used on the project) or Contractor.

The Contractor will also be a "Designer" within the requirements of the regulation for any contractor design.

Please also note that the Contractor will be expected to meet with the Council/Client/PD and stakeholders prior to commencement on site to assess the health and safety, logistical and practical approaches to the contract

He shall allow for the production of all such Risk Assessments and Method Statements as may be required by the Principal Designer (PD) in the preparation of the relevant Health and Safety documents and shall fully cooperate with the PD throughout the contract works..

#### **1.23 MANUFACTURERS INSTALLATION INSTRUCTIONS AND RECOMMENDATIONS**

All plant and equipment specified shall be installed in accordance with the relevant Manufacturers recommendations, unless specifically stated otherwise.

#### **1.24 OPERATIONAL INSTRUCTIONS**

The Mechanical/Electrical Contractor shall, at a time to be agreed before completion, instruct the Employer or his representative, on site, in the use and operation of the engineering services installations.

This shall take the form of formal training sessions on site and the contractor shall allow for a minimum of one day training to cover all services and systems.

The Mechanical/Electrical Contractor shall satisfy himself that the Employer is capable of taking over the installations.

#### **1.25 EMC COMPLIANCE**

The Contractor shall ensure that all products and installations shall fully comply with the Electro Magnetic Compatibility European & other standards including:

- .1 EN 50081-2 EMC - Generic Emission Standard Part 2
- .2 EN 50082-2 EMC - Generic Immunity Standard Part 2

The Contractor shall inform the Consulting Engineer / Employer of any areas of non-compliance of specified items / installations.

#### **1.26 CONTRACTOR DESIGNED ELEMENTS**

The mechanical and electrical contractor will develop an outline design as defined within these ER's to a full installation design and full set of working/installation drawings to comply with this ER/Specification. He shall include where required for specialist design for specific items. Such items are mainly confined to specialist services where final selection of appropriate equipment and positions of devices, and the routes of cabling or pipework to serve these devices shall be the responsibility of the specialist.

The scope of works and workmanship clauses indicate where the mechanical and electrical contractor shall engage such specialists as necessary.

#### **1.27 ASBESTOS MATERIALS**

The contractor is advised that due to the age and construction of the existing building, there is the possibility of Asbestos being present within the building fabric. The Contractor shall examine and familiarize himself with the Site Asbestos Register and the recent refurbishment and demolition survey provided within the tender package and shall not disturb any materials known or suspected to be Asbestos based or which may contain Asbestos fibres.

Note that recent works have been carried out to the existing plant room to remove the known asbestos materials. The contractor shall review all records associated with this removal prior to commencing work.

If any materials are found that are suspected to contain asbestos, all works shall cease immediately, the area shall be secured and all operatives, public and site staff excluded from the area.

A specialist shall test the material and carry out all necessary air tests to ensure that the area is safe prior to any works recommencing.

Any materials that are proven to contain asbestos or asbestos related materials shall be removed under controlled conditions by an approved company and disposed of at a registered disposal site.

#### **1.28 MAINTENANCE DURING DEFECTS PERIOD**

In general, the contractor shall include for routine maintenance of all items of plant installed during the contract period in accordance with the manufacturers' recommendations for a period of twelve months from Practical Completion.

#### **1.29 SAP/SBEM**

The contractor and his designer shall allow for the production of all necessary information to carry out or contribute to the assessment of the building under the above assessment protocols.

Where required as part of the heating system design, and to prove compliance with Part L of the Building Regulations, the Contractors Designer shall construct a thermal model within approved software from TAS or IES such that the building performance can be assessed. If a Thermal model is not to be provided, the Contractor shall ensure that heat loss calculations and sizing of plant is such that Part L is satisfied.

Where new ventilation is installed, the Contractor shall ensure that Specific Fan Powers (SPF) are in compliance with the Building Regulations requirements.

## 2. DEFINITIONS

The definitions of terms used in this Employers Requirements Document are as follows.

"Employer" shall mean **Council of the Isles of Scilly** and shall include all persons duly authorised by them to act on their behalf.

" Project Manager" shall mean **Council of the Isles of Scilly**

"Consulting Engineer" shall mean **IQ Engineering Consultants** Ltd Unit 41 Teignbridge Business Centre, Cavalier Road, Newton Abbot Devon, TQ12 6TZ.

"Tenderer" shall mean the Mechanical & Electrical Contractor(s) invited to Tender for the works described in this Specification.

"Mechanical/Electrical Contractor" shall mean the Contractor appointed to carry out the works when Tenders have been evaluated.

"Contract" shall mean the Contract entered into by the Main Contractor with the Mechanical/Electrical Contractor for the execution of the Mechanical and Electrical Engineering Services installations.

"Sub-Contract" shall mean the Contract entered into by the Mechanical/Electrical Contractor for any specialist sub-contract works.

"Employers Requirements" shall mean this document and all accompanying schedules and appendices and any amendments issued prior to the Tender return date.

"Drawings" shall mean the drawings issued for Tender as listed in the Employers Requirements or on appropriate issue sheets and any amendments issued prior to the Tender return date.

**3. THE CONTRACT**

The Conditions of Contract shall be: NEC 3 Short form Contract.

**As per Main Contract Documents**

To arrange a site visit, the Tenderer shall contact:-

**Council of the Isles of Scilly**

[mhr@scilly.gov.uk](mailto:mhr@scilly.gov.uk)

For the attention of

**Mr K Grossett or Mr S Parsons**

The Town Hall  
Hugh Town  
St Marys  
Scillonia  
TR21 0LW

Phone:01720 424000

## 4. PROJECT SPECIFIC TECHNICAL REQUIREMENTS

### 4.01 GENERAL OVERVIEW

This project involves the Design and Build Refurbishment of the heating services to the Mundesley Boarding house together with alterations to hot water generation.

The building is a rendered brick constructed block which operates as a standalone building with its own electrical supplies derived from the WPD network which enter the GF in a corridor.

The two rear apartments also have their own dedicated electrical supplies fed from meters external to each apartment.

Boiler plant is currently located within the existing plant room to serve the heating and hot water requirements of the building.

The oil fired heating has proved expensive to run, is poorly zoned and controlled and the cost of shipping oil to the island is becoming prohibitive.

The system is to be replaced with a simple electric heating system throughout which shall incorporate zoned and timed control such that it can be shut down when not in use and energy use optimised.

The existing heating plant and pipework shall be removed and disposed of as required.

It is proposed that hot water will be retained as existing within the building as it is a circulated secondary type system and serves all existing points of use.

The exception to this however is the hot water services to the existing rear apartments which shall be separated from the main system by modification of existing pipework and shall be fitted with their own electrically operated water heating by means of a cylinder or storage heater and electric over bath shower.

The calorifier is however life expired and shall be replaced with a new mains fed cylinder incorporating both immersion heating and solar thermal\* alternative energy supplies to generate the required hot water.

*\*Alternative technologies may be considered but the contractor shall price an ER compliant scheme with any alternatives listed as a variation and appropriately costed. Non ER compliant schemes will be rejected.*

All works shall comply with the relevant applicable standards including but not limited to the following.

- Educational Building Bulletins
- Relevant British Standards
- Relevant British Standard Codes of Practice
- The Wiring Regulations BS7671
- CIBSE Guides
- ASRAE and BSRIA Guidance

External infrastructure including electricity and water will be derived from the on-site infrastructure



The existing WPD incomer is being checked for suitability and early enquiries are submitted to WPD together with approximate heating loads to enable them to check local capacity and network loadings..

The building will be heated using new Electrical heating emitters served from new electrical distribution. A proposed main and sub-distribution system is noted on the concept schematics but variations and consolidation shall be acceptable depending upon the contractors design solution.

Preference shall be given to a passive heating system using convector type heaters, however it will be acceptable to use fan convectors where heat losses are significant provided that the design is based on using these units on their lowest speed setting for acoustic reasons.

All heaters shall be low surface temperature and touch safe. Any heater that cannot be demonstrated as LST and there are no suitable alternatives shall be fitted with a wire mesh guard which shall be securely fixed.

All controls on heater units shall be secure and tamper proof such that when set, they cannot be altered by the room occupants.

#### **4.02 BUILDING SERVICES**

The Contractors shall review all relevant architectural contract documentation and shall ensure that they have allowed for all items that may be required by the contract. There are no services drawings to be provided other than the generic concept schematics, scope of works or zoning drawings, as it is envisaged that sufficient information will be within this Employers Requirements Document to permit the Contractor to design the services to each space.

A schedule of common design criteria to be adopted is included within this Employers Requirements Document with any specifics included within the relevant clauses of this Document.

This is for the design, supply and installation, testing, commissioning and setting to work of the following building services systems in all areas of the main teaching block.

##### **Works required**

###### *Mechanical*

- Survey and remove any Asbestos in Plant rooms and ducts where accessible without major building works. Seal inaccessible areas and disconnect and abandon services within.
- Disconnect and make safe oil and electrical supplies to boiler plant and controls
- Disconnect and strip out life expired boilers and burners in plant room
- Strip out plant room pipework and pumps with the exception of HWS services.
- Strip out life expired calorifier but retaining existing water supply, flow and return pipework for reconnection to new unit.
- Modify pipework to two apartments to remove them from the circulated hot water service but ensure that circulation is reinstated throughout the rest of the boarding house.
- Strip out and remove all redundant controls and panel
- Strip out all emitters together with all pipework within the boarding house building and apartments. Where pipework cannot be removed or accessed without significant damage to décor and finishes, it shall be cut back, and filled with inert material such as expanding foam before being capped and buried. The use of inert material is to prevent further corrosion and potential future collapse where pipes are buried direct in the fabric.
- Engage a builder and decorator to facilitate the repairs to décor where pipework and radiators are removed. Allow for this work within the tender.
- Assist with design supply and installation of new heating (see electrical below)
- Design supply and install new HWS system consisting of new calorifier of the same size and flow rate as per the present unit. Reconnect to existing flow and return and main CWS.

- Within the two rear apartments, design supply and install new water heating to serve all existing points. The larger apartment may require a storage calorifier and the smaller a simple storage type water heater of adequate capacity for the points served.
- Design a Solar Thermal generation system consisting of roof mounted solar collectors of the high efficiency evacuated tube type which shall serve an indirect coil within the cylinders for the boarding house to generate as much hot water as possible from free solar energy\*.
- Interlock the immersions such that solar generation is prioritised and immersions inhibited when there is sufficient output from the solar coils to heat the calorifier.

*\*Alternative technologies may be considered if the Contractor can demonstrate a cost benefit and reduced payback on behalf of the Client*

### *Electrical*

- Calculate fabric heat losses in each space served by new electric heaters.
- Calculate heat input required to each space including those where frost protection only is required. Heat input to take account of both fabric losses and those due to infiltration and ventilation.
- Design supply and install new electrical distribution to serve all heating equipment and new water heating.
- Design supply and install appropriate sub-metering
- Design supply and install controls to provide time and temperature
- Design controls to permit zoning of heating and optimisation on outside and inside temperature
- Design supply and install electric heaters to all spaces which shall be Low Surface Temperature and touch safe.
- Rewire existing re-used mechanical plant such as secondary pumps etc as required.
- Design supply and install new controls to re-used mechanical plant or integrate with overall control system.
- Design supply and Install new emitters throughout sized on revised heat losses. These are to be either electrical convector radiators with thermostat control in all spaces, or by Fan Convectors if to Client preference to decrease wall space used and to minimise warm up response time.
- Design and install new control panel and fully integrated Building management system with touch screen panel and web interface to permit control over the IT network.
- Configure controls to operate all plant on time and weather compensation with sensors in each controlled zone.
- Commission controls
- Carry out final commission and seasonal commissions as required
- Engage building and decorating contractor to make good all damage to decoration and fabric and to box in/encase cable runs as required.
- Prepare and issue all certification and handover documentation
- Test and certify all new works
- Prepare and issue certification and handover documentation.

The list above is intended as a general guide to the services to be provided under the contract. It is not exhaustive and the Mechanical and Electrical contractor shall refer to the scope of works within this specification, any drawings and E.Rs for further details of all the services required.

The Contractor shall allow for employing specialists to carry out the design of the works as required to satisfy the design criteria set out in this document.

The contractor shall be responsible for all payments to these specialists and shall include for any charges incurred in his tender.

In general, the Contractor shall include for routine maintenance of all items of plant installed during the contract period in accordance with the manufacturers' recommendations for a period of twelve

months from Practical Completion. This does not relieve the Contractor of his contractual responsibilities with respect to defects liability.

The contractor is required to produce coordinated working drawings at the outset of the project and that these shall be submitted to the Consultants in good time to enable comment to be made prior to commencement of installation works.

He shall also produce coordinated drawings of congested areas and shall demonstrate that his proposals for equipment and systems to comply with the Employers requirements can be installed within the available space.

Upon completion, the Contractors shall produce all required "as fitted" drawings as defined within this document. These shall be included within the Operation and Maintenance Manuals.

The Contractor is advised that failure to produce all required documentation at handover will result in delay to the payment of final accounts.

The Contractor is advised to carry out a site visit prior to tendering for the works. The Client shall not be financially responsible for any items that could reasonably have been foreseen if this condition had been complied with.

The Electrical Contractor shall liaise with the Mechanical Contractor and other trades to ensure all required coordination of services is carried out prior to commencement of the installation.

The Contractor shall advise the Consultants in good time of any proposed changes to specified items and shall take responsibility for ensuring that these items can be installed within the available space.

The Contractor shall supply all equipment, materials, tools, labour and all necessary items for the complete supply, delivery, off-loading, location, installation, connection, testing and commissioning of the installation in accordance with the ER's and drawings and to the complete satisfaction of the Consulting Engineers.

The ER's shall be read in conjunction with the drawings and the Tenderer may obtain any further details he may require for the purpose of tendering from the Consulting Engineers.

In the event of there being a variation between the drawings and ER's, the Consulting Engineers will decide the matter and no extra will be allowed. The drawings and ER's shall be deemed to be complementary each to the other and any item shown on the drawings but not described in the ER's and vice-versa shall be deemed to be included.

The drawings are intended to indicate the general scope of the installations and is not intended as a working or design drawing.

The containment, pipework and ductwork etc., shall be fixed in the neatest possible manner employing all the fixings, fittings or sets to accomplish this to the entire satisfaction of the Consulting Engineers and work condemned on this account shall be removed and replaced without additional cost.

As far as is reasonably practicable, the entire installation shall be concealed flush except where surface trunking is used intentionally to offer flexibility.

At the time of tendering any proposed departure from the ER's and drawings shall be clearly stated, and any comments with regard to the efficacy of the design, availability of materials and time to complete the work shall be made.

In general this section of the ER's is complementary to the other sections. However in the event of any apparent contradiction, the requirements as stated hereinafter shall be taken as correct.

## DESIGN STANDARDS

Comply fully with the edition (including amendments) of each of the following, current at the time of tender: -

## ELECTRICAL STANDARDS

BS 951	Electrical earthing. Clamps for earthing and bonding. Specification
BS 1363	13 A plugs, socket-outlets and adaptors.
BS 1853	Tubular fluorescent lamps for general lighting service.
BS 4678-1	Cable trunking. Part 1: Steel surface trunking
BS 4678-4	Cable trunking. Part 4: Specification for cable trunking made of insulating material
BS 5266-1	Emergency lighting. Part 1: Code of practice for the emergency lighting of premises
BS 5378	Safety signs and colours.
BS 5486-12	Low-voltage switchgear and control gear assemblies. Specification for particular requirements of type-tested miniature circuit-breaker boards
BS 5733	Specification for general requirements for electrical accessories
BS 5839	Fire detection and alarm systems for buildings.
BS 5839-1	Fire detection and fire alarm systems for buildings. Part 1: Code of practice for system design, installation, commissioning and maintenance
BS 5839-6	Fire detection and fire alarm systems for buildings. Part 6: Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings
BS 6387	Specification for performance requirements for cables required to maintain circuit integrity under fire conditions
BS 6724	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
BS 7211	Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
BS 7430	Code of practice for earthing
BS 7629	Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire
BS 7671	Requirements for electrical installations. IEE Wiring Regulations
BS EN 54	Fire detection and fire alarm systems.
BS EN 1838	Lighting applications. Emergency lighting
BS EN 60439-3	Specification for low-voltage switchgear and control gear assemblies. Part 3: Particular requirements for low-voltage switchgear and control gear assemblies intended to be installed in places where unskilled persons have access to their use.
BS EN 60598	Luminaires. Particular requirements
BS EN 60598-2-22	Luminaires. Part 2-22: Particular requirements. Luminaires for emergency lighting
BS EN 60947	Low-voltage switchgear and control gear
BS EN 61008	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs).
BS EN 61009	Electrical accessories. Residual current operated circuit-breakers with integral over-current protection for household and similar uses (RCBO's).
BS EN 61386-1	Conduit systems for cable management. Part 1: General requirements
BS EN 61386-21	Conduit systems for cable management. Part 21: Particular requirements. Rigid conduit systems
ICEL 1001	Scheme of product and authenticated photometric data registration for emergency luminaires and conversion modules.
ICEL 1004	Requirements for the re-engineering of luminaires for emergency lighting use
ICEL 1009	Emergency lighting central power supply systems standard and registration scheme

## MECHANICAL STANDARDS

The Building Regulations

The Water Supply (Water Fittings) Regulations

BS 416	Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron
BS 1710	Specification for identification of pipelines and services
BS 3868	Specification for prefabricated drainage stack units in galvanised steel
BS 4118	Glossary of sanitation terms
BS 6465	Sanitary installations
BS EN 1057	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1329	Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly (vinyl chloride) (PVC-U)
BS EN 1451	Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP)
BS EN 1566	Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Chlorinated poly(vinyl chloride) (PVC-C)
BS EN 12056	Gravity drainage systems inside buildings
BBA	British Board of Agrément Certificate as appropriate.
BS 4213	Cisterns for domestic use. - Cold water storage and combined feed and expansion (thermoplastic) cisterns up to 500L. Specification
BS 6700	Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification
BS 7181	Specification for storage cisterns up to 500L actual capacity for water supply for domestic purposes
BS 7592	Methods for sampling for Legionella organisms in water and related materials
BS 8000	Workmanship on building sites
BS 8000-15	Part 15: Code of practice for hot and cold water services (domestic scale)
BS EN 806	Specifications for installations inside buildings conveying water for human consumption
BS EN 806	Part 1: General
BS EN 806	Part 2: Design
BS EN 13076	Devices to prevent pollution by backflow of potable water. Unrestricted air gap. Family A. Type A
BS EN 13077	Devices to prevent pollution by backflow of potable water. Air gap with non-circular overflow (unrestricted). Family A. Type B
BS EN 13959	Anti-pollution check valves. DN 6 to DN 250 inclusive. Family E, type A, B, C and D
BS EN 14154	Water meters
BS EN 14451	Devices to prevent pollution by backflow of potable water. In-line anti-vacuum valves DN 8 to DN 80. Family D, type A
BS EN 14453	Devices to prevent pollution by backflow of potable water. Pipe interrupter with permanent atmospheric vent DN 10 to DN 20. Family D, type C
BS EN 14623	Devices to prevent pollution by backflow of potable water. Airgaps with minimum circular overflow (verified by test or measurement). Family A, type G
BSRIA AG 4/94	Guide to Legionellosis - temperature measurements for hot and cold water services
CIBSE TM13	Minimising the risk of Legionnaire's disease
CIBSE	Design Guides
CIBSE	Technical Memoranda
CIBSE	Guide G Public health engineering
BS 5779	Specification for spray mixer taps
BS 6700	Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification
BS 7592	Sampling for Legionella bacteria in water systems. Code of practice
BS 8000	Workmanship on building sites
BS 8000-15	Part 15: Code of practice for hot and cold water services (domestic scale)
BS EN 1111	Sanitary tapware. Thermostatic mixing valves (PN10). General technical specification
BS EN 1287	Sanitary tapware. Low pressure thermostatic mixing valves. General technical specifications

BSRIA AG4/94 Guide to legionellosis – temperature measurements for hot and cold water services  
HSC ACoP L8 The control of legionellosis bacteria In water systems  
IOP Plumbing Engineering Services Design Guide  
WRAS Water Regulations Guide Second Edition  
WRAS Water Fittings and Materials Directory

#### 4.03 SCHEDULE OF COMMON DESIGN CRITERIA

External design conditions:	Winter	-1 °Cdb. 90% RH	
	Summer	27 °C db. 50% RH	
	Night time noise levels - external:		50 dB(A)
	Day time noise levels - external:		60 dB(A)
Internal design conditions: <i>To be compliant with Building Bulletin BB101</i> <i>Temperatures taken at 0.5m above Finished Floor Vertical Temperature gradient not to exceed the temperature at floor level by 3°C at 2m</i>	Study areas	18 °C	
	Living Rooms	21 °C	
	Toilets/shower rooms	18°C	
	Bedrooms/Dormitory	18°C	
	Noise levels (max):	NR 30 - 40	
Ventilation design criteria: All occupied Areas  <i>To be compliant with Building Bulletin BB101</i>	Fresh air rate for occupants	Min 3l/s per person for maximum number of occupants	
		8l/s per person summer minimum	
	Average Occupancy (dorm rooms)	1 person per 4.5m <sup>2</sup>	
Ventilation design criteria: Offices	Fresh air rate for occupants	Min 10l/s per person for maximum number of occupants	
	Air change rates – Toilets	Min 6 ach/Hr	
Co2 Maximum levels ( <i>all teaching/learning spaces</i> )	1500ppm average through the day	Maximum peak	
	5000ppm		
Thermal design criteria:	Small power heat gain	10 W/m <sup>2</sup>	
	Occupancy heat gain	100 W/person (sen) 40 W/person (latent)	
	Lighting heat gain	15 W/m <sup>2</sup>	
Design operating conditions:	HTG operating touch temperature	60 °C (max)	
	DWS operating temperature	60 °C (max) Mixed and thermostatically controlled to 43°C in accessible WC s and for vulnerable persons.	
	DWS operating pressure	1.5 bar (max)	



## Equipment Selections

Any component pressure drops etc. quoted in individual Work Section selection schedules are "notional" figures used for the purpose of preliminary plant and motor selections.

Where "maximum" figures are quoted these are not to be exceeded when selecting equipment. The Engineering Services Contractor shall substitute the actual pressure drops, flow rates etc. through all components, as purchased and as the final installation configuration, and recalculate equipment duties before selecting and ordering equipment and associated prime movers.

Twin 13 amp switched socket outlets and other general power accessories to be installed as below unless specifically noted on the architectural drawings as at an alternative height:-

<b>Circuit/Accessory</b>	<b>Height above Finished Floor</b>
<b>Consumer Units/Distribution Boards</b>	2000mm to top of highest breaker
<b>Light Switches</b>	1200mm max as Part L
<b>Pull Cords (Lighting)</b>	1050mm to lowest point of drop cord
<b>Pull Cords (Emergency Call)</b>	450mm to lowest point of drop cord
<b>Cooker Control Unit</b>	1050mm (or to suit tile coursing )
<b>Kitchen Sockets</b>	1050mm (or to suit tile coursing )
<b>General Sockets</b>	600mm or 1100mm if above desks in Dado
<b>Room Thermostats</b>	1450mm
<b>TV antenna Points</b>	600mm
<b>BT/Network Points</b>	600mm or 1050 if above desks
<b>Spurs for space heaters</b>	600mm with flex outlet to heater
<b>Spurs for water heaters (under sink)</b>	1050mm (or to suit tile coursing ) with flex outlet adjacent to heater
<b>Under Counter appliances</b>	1050mm (or to suit tile coursing ) with socket outlet behind appliance at 600mm

Where the building layout or other constrictions prevent the installation at the specified heights, the contractor shall advise the Consultant/Contract Administrator and agree an alternative.

Ensure that the proposed position of all electrical fittings support the stated furniture layouts and activity zones for the spaces; and have full regard to radiator positions, door swings etc.

## 4.04 V20 LV POWER DISTRIBUTION

### Performance Objectives

To provide a system for the distribution of low voltage electrical power to end user points via a robust and reliable electrical distribution system.

This shall be deemed to be exclusive to the renewal of the heating system only for the purposes of this contract.

No other rewiring work is to be carried out other than that associated with heating controls and replacement plant.

The incoming supply shall be checked for suitability and capacity for the new heating system load which shall be kept to a minimum as far as is reasonably practicable.

Preliminary enquiries have been placed with Western Power Distribution and the successful tenderer will be provided with all relevant information to enable them to liaise directly with WPD.



### System Description

The contractor shall design supply, install, commission and set to work, a complete Low Voltage distribution system as detailed within these Employers Requirements.

It shall be acceptable to consider relocation of the mains to within the existing plant room as there is greater space available to permit installation of switchgear and control equipment.

The characteristics of the supply are estimated as follows. The value of PSC and Ze are generic standards advised by the REC and shall be confirmed on site by the electrical contractor and the Engineer advised prior to commencement of the works. Any disparity between the advised and actual values may require a recalculation of cable sizes, therefore the electrical contractor shall not carry out any works until these values have been confirmed.

System Supply Voltage	400/230
PSC at origin	16kA (to be confirmed)
Frequency	50Hz
Earthing System	TNC-S
External Earth Loop Impedance	0.025 Ohms (to be confirmed)

Design, supply and install new electrical distribution associated with replacement heating throughout the new building.

The cables serving existing plant that are noted to be in good condition and appropriately sized can remain in place but all tails shall be sleeved with heat shrink cable sleeving of the new colour code so that consistency is maintained throughout the installation. The sleeved tails shall be covered from the point where they exit the cable oversheath to the point of termination so that none of the previous colour code is visible.

Dedicated distribution boards shall be provided where required.

Main distribution boards that require breakers in excess of 63A rating shall be MCCB type and all boards with breakers smaller than 63A shall be MCB type.

For all boards a minimum of 25% spare capacity shall remain after connection of all existing circuits

### **GENERAL**

All new switchgear where required or indicated on the drawings shall be from a reputable manufacturer with good spares availability.

All MCCBS shall be a minimum of 25kA fault rated and MCBs shall be a minimum of 10kA fault rated.

For any new submains installed as part of the Contractors design, the contractor shall run supplementary CPC's with all submains and shall not rely on the cable armouring as the sole CPC for any cable. The CPC shall be equal to the phase conductor CSA in all cases up to 35mm<sup>2</sup> and half size from 50mm<sup>2</sup> upwards with a minimum of 35mm<sup>2</sup>

The sub-mains and CPCs shall be intentionally oversized along with the distribution to permit future development to take place in these areas of the school. Note that 25% over capacity shall be available on all boards.

The sizes and ratings of all such cables and tails shall be agreed with the Consultant and calculations submitted for comment and approval.

All cables shall be BASEC approved and made no more than twelve months prior to the installation.

All cables shall be fitted with identification labels at both ends. These shall be securely fixed and as such, self adhesive type cable markers are not acceptable for this purpose.

Termination at both ends shall be by means of suitably sized brass cable glands, lock washers and sealing boots that are suitable for the cable to be used and in compliance with the cable manufacturers requirements.

The glanded termination shall be fitted with a tag washer to permit the connection of a bonding wire between the tag washer and the earthing bar within the board.

The supplementary CPC to be run with the submain shall be attached to the submain cable with cable ties and shall be terminated at the distribution board by means of a lug and bolted connection.

The incoming isolator to each of the new Triple Pole or Single Pole Miniature Circuit Breaker sub-distribution boards or control panels located within the building shall be a Switch Disconnecter and nominally rated at 125A minimum for Power distribution or of a rating higher than the protective device serving the respective distribution board.

Note that to achieve discrimination on power circuits, a higher rating may be required to back up the supply to each board than the board load would suggest. A discrimination calculation will be required as part of the technical submission where breaker sizes are close between sub –circuit and sub-main protective devices.

For control panels, the isolator rating shall suit the connected load and rating of the upstream device.

The busbars within each board shall be fully rated to the capacity of the incoming isolator.

A conspicuous warning notice shall be fixed to the distribution boards or control panel indicating the voltage to be found within and the point of isolation.

In addition, each board or control panel shall be labelled with its designation and fitted with NIC-EIC inspection and test labels fully completed and signed as required.

A circuit chart, A4 in size shall be affixed adjacent to each distribution board in a glazed frame. This chart shall indicate the circuits fed, protective device ratings and number of points served.

#### **SUPPLIES TO PLANT CONTROL PANELS**

New control panels associated with the BMS replacement and upgrade shall be provided with new incoming supplies derived from the building distribution but shall in general consist of XLPE/SWA sub-mains sized appropriate to the load of the of the Motor Control Centre and connected plant..

#### **ELIMINATION OF PIPED SERVICES**

With the exception of piped services associated with a fire suppression system, no pipework shall cross above the distribution boards and the layout of the plant rooms and coordination of these shall take due consideration of this requirement.

#### **WARNING NOTICES/INFORMATION**

Conspicuous and indelible notices reading "DANGER - High Voltage" shall be provided on all lockable doors to rooms containing or giving access to high voltage equipment.

## **ELECTRICAL SAFETY**

Rubber mats complying with BS 921 shall be provided to the front of wall mounted switchgear in the dedicated switchrooms/cupboards.

## **SYSTEM DIAGRAMS**

A system schematic shall be provided and mounted in each switchroom (A3 size min).

## **LIGHTING**

Emergency lighting shall be provided in the vicinity of all distribution boards and Control Panels.

Specifically new emergency lighting shall be provided in the refurbished plant rooms to BS5266

### **4.05 V21 GENERAL LIGHTING**

#### Performance Objectives

The contractor shall design, provide, install, commission and set to work a complete lighting system within the existing plant room to upgrade lighting to current standards.

The plant room shall in future be used for the hot water calorifier, the solar thermal package and storage only.

The contractor shall check the light level in the plant room and shall upgrade it with LED fittings on existing wiring to the following standard:-

It shall achieve 200Lux at floor level throughout the plant rooms.

#### Maintenance factor:

The maintenance factor for the lighting system shall be dependent on the type of space. The following regime defines this for all areas. The contractor shall submit lighting calculations for all areas and provide the maintenance factor on the factors below. Should the contractor wish to use a different regime and hence maintenance factors the contractor shall provide written statement describing the reasons for the change.

LLMF – As defined by the lamp manufacturer based on 12000 hours  
LSF – Spot replacement  
LMF – 1.0 year – normal environment  
RSMF – 1.0 year – normal environment

Where LED is used, these LLMFs shall be adjusted accordingly

#### System Description

The contractor shall design supply, install, test, commission and set to work a complete lighting system to serve the refurbished plant room.

It will be the contractors responsibility to check the layouts of spaces and light levels required and to supply all necessary lux plots to prove the design prior to installation.

The new lighting system shall in general, consist of surface fittings as appropriate to the ceiling formation.

All luminaires shall be chosen to use LED Technology and shall be of a high quality offering a minimum of 50000hours life span and an LED chip or chip array from a reputable supplier.

All LED fittings shall be of a colour temperature of 3000-3500K equal to standard cool white fluorescent as used elsewhere in the school. This is intended to avoid the strong visual contrast that could occur using LED in its natural colour of 6000K. It is noted that there is a small energy efficiency penalty for using the lower colour temperature.

Note that in respect of the LED lamps or fittings, cheap imports from unidentified or traceable sources are not acceptable.

One luminaire adjacent to the escape shall be fitted with integrated emergency gear.

All emergency supplies shall be fed via secret key switch operated test points to be located in the local grid plate unless otherwise specified.

The test points shall be engraved "Emergency Lighting – Test Point" in red lettering on each plate.

All grid switch elements shall be 20A rated and suitable for inductive load switching.

Grid switches shall be mounted in deep back boxes such that the cables into the switches can be installed without being compressed or kinked.

All new lighting circuits shall be wired in LSF insulated cables contained within cable basket above ceilings or in voids with containment sized appropriate to the number of circuits.

Upon completion of the lighting installation, all luminaires shall be cleaned free of dust and debris.

Louvres and other optical controllers shall be installed just prior to handover using protective gloves such that the optical surface is not marked.

All lights to be robust quality and IP44 splash proof rated.

All clauses within section V21 (General Lighting) apply to this project

#### **FIRE PROTECTION**

Where fittings are used that breaks through the fire integrity of the ceiling where this forms the horizontal fire break, the contractor shall include for the supply and installation of suitable fire boxes or blankets as per the recommendations of the luminaire manufacturer. Refer to Fire Plans.

#### **LUMINAIRE CLEANLINESS**

Upon completion of the lighting installation, all luminaires shall be cleaned free of dust and debris. Louvres and other optical controllers shall be installed just prior to handover using protective gloves such that the optical surface is not marked.

### **4.06 V22 GENERAL POWER**

#### Performance Objectives

To provide a complete general power system which shall be appropriate to serve the new heating systems general power supplies.

Power services shall be confined to supplying energy to new plant and systems associated with the heating services. No other rewiring or alteration work is envisaged as part of this contract.

## System Description

### **GENERAL**

The Electrical Sub-Contractor shall provide the complete general power system to serve the new heating system.

This shall include the provision of general and specialist use outlets as required.

Design, supply and install all new switchgear where required to feed these new circuits. All distribution shall be from a reputable manufacturer with good spares availability.

All breakers shall be 10kA rated as a minimum.

All general power circuits shall be RCD protected. RCDS shall be 30mA rated.

### **MAIN AND SUB DISTRIBUTION**

At the mains position, the contractor shall design supply and install a new MCB type distribution board which shall be connected to the existing or upgraded metering. The board shall be fitted downstream of a new main isolator which the contractor shall size and install at the origin of the installation.

The new MCB board shall be used to serve new heating supplies and the existing electrical services as indicated on the schematic.

Where required by the contractors design and in accordance with the general concept schematic as provided, the contractor shall allow for a number of remote contactor controlled MCB boards to serve the local heating in each zone.

The boards shall be three phase and the load of the heaters shall be equally balanced across the three phases. It is noted that the nature of thermostatically controlled heaters will unbalance the load as they switch on temperature but when all heaters are in operation, the loads shall be balanced as far as is reasonably practicable.

All MCB boards within dormitory and "public" access areas shall be lockable and secure.

Remote boards in each zone shall be contactor controlled with the contactors switched by a zone controller on time and temperature.

A tamper proof zone sensor shall be provided in each heating zone to provide overall control of the space heating in the respective area. (see Heating later in this specification)

The sub distribution boards shall all be three phase units to permit sharing of the load across the phases. Single phase boards shall not be used unless it can be proven that the loads will remain balanced throughout the system as far as is reasonably practicable.

It shall be permitted to run circuits from a single three phase board depending on the contractors design but zoning control shall then be achieved by the use of an extension box fitted to the board which shall contain the contactors switching the outgoing circuits.

The contractor may elect to use heaters with inbuilt controls whereby a permanent supply is maintained and control achieved with a data connection or other means of remote control. (see heating clauses later in this specification)

### **APARTMENTS**

Within the two rear apartments, additional load will be added in terms of new electric heating, water heating and showers. Contractor to allow for assessment of this load in respect of existing capacity

on the distribution boards as the boards are likely to be under sized for the additional circuits to be added.

For tendering therefore, the contractor shall allow for the design, supply and installation of new distribution boards into each apartment which shall be installed to current standards and be split load type with power circuits all on RCD controlled ways and lighting and refrigeration circuits on non RCD controlled ways.

The boards shall be sized to allow installation of all existing circuits plus the new heating, water heating and shower circuits and allow a minimum of 2 spare ways when all circuits are connected.

#### **FLAT 2 METERING AND DISTRIBUTION (ACCESS FROM MAIN HOUSE)**

Within flat 2, the contractor shall design, supply and install two dedicated sub-meters to monitor the energy usage of the flat for both general lighting and power as well as the new heating.

The meters can be sited either close to the board in the flat or may be incorporated within the section board at ground floor level such that access is not required to the flat to read the meters

The meters shall be direct reading in line type with digital display and battery backup. They shall be set at installation and sealed such that no changes to meter programming or function is possible by unauthorised persons.

The contractor may consider consolidating the heating and general lighting and power DBs to this flat into one supply which shall be metered as noted above.

This option will be considered only if zoning and control of the heating can be achieved as set out previously.

#### **TRUNKING/CONTAINMENT SYSTEMS AND WIRING**

As far as is reasonably practicable, all wiring shall be concealed within the fabric of the building or within purpose made cable ways that maintain the internal appearance.

Where trunkings or conduits are required, the following shall apply:-

All wiring shall be installed within suitable containment such as trunking and conduit for vertical drops and cable basket or tray for main horizontal runs within ceiling voids.

It shall be permissible to use loose gather P clips secured to the building fabric for sub runs departing from the main routes to serve specific accessories or points.

All such runs shall be installed in straight runs which shall be perpendicular to each other, properly formed and loomed and shall not run point to point.

The types and cable sizes to be used for final circuit wiring shall be selected by the Contractors designer appropriate to the load on the circuit but a minimum cable size of 1.5mm<sup>2</sup> shall apply.

In general, the small power installation in all areas of the building shall be carried out using LSF insulated cables installed in trunking/conduits for vertical drops, tray or basket for main runs, and loose gather clips for spurs subject to the agreement of the supervising engineer.

Cables run within stud partitions shall be suitably protected from accidental damage by covering with a metallic barrier such as conduit where they cannot be placed greater than 50mm below the surface.

If the 50mm space cannot be achieved, all circuits within the stud partitions shall be RCD protected as required by the current edition of BS7671.

Sensor wiring and data wiring shall be segregated from the power wiring where trunkings or other containment systems are shared by means of a metallic segregation barrier.

### **13AMP FUSED CONNECTION UNITS**

All new heaters shall be provided with a fused connection unit adjacent to the heater. Where there is a possibility that these will be tampered with, they shall be unswitched type and fitted with a fuse that only be removed by the use of a tool.

All 13Amp fused connection unit accessory plates shall be from a reputable manufacturer with good spares availability and match the lighting and socket outlet plates for the area under consideration, except for where connection units are located within ceiling voids where the surface switched metal clad pattern shall be installed.

Fused connection units that form part of a ring circuit shall be wired as part of the ring main circuits. Spurs shall not be used.

Design, supply and install radial circuits to serve all new heaters.

All fused connection units shall be fitted with fuse links rated to suit the connected equipment.

Fused connection units shall be of the switched or un-switched pattern as required and where appropriate be complete with flex outlet and neon indicator.

All final connections shall be carried out using cable/flexible cable of the same current rating as the hard wired circuit conductors, or of a rating that can carry the full current permitted by the largest fuse that may be fitted within the connection unit.

Final connections to heat generating appliances shall be made using heat resisting flexible cables such as Butyl rubber or equal.

Fused connection units shall be installed adjacent to or at high level to the item of equipment that it serves such as the following;

- Heater Units
- Supplementary protection to BMS Control Contactors

All outlet plates shall be labelled with the circuit reference to which they are connected. Labels shall be high quality and indelible using red or black lettering on a clear background and securely fixed to the accessory with self adhesive backing as P-Touch, Dymo or equal.

### **ELECTRICAL WIRING FOR MECHANICAL SERVICES**

(See also section Controls and Monitoring)

Design supply and install all electrical services and containment associated with mechanical services plant, controls and monitoring as required to achieve a fully operational mechanical installation running under full BMS control.

This section is written generically as the scope of works associated with the heating and HWS installation will depend on the contractors design.

It is however likely that the control works in this block will include but not be limited to the following:-

- Wiring and provision of containment for all sensors
- Wiring of new points for mechanical services
- Installation of suitable interfaces for BMS
- Installation of suitable interfaces to Fire Detection systems and other services as required.

The mechanical plant and controls equipment in the building shall be designed, supplied and installed under the mechanical sub-contract works contract.

The Mechanical Sub-Contractor shall also carry out all controls wiring from the mechanical services control panel to items of equipment associated with the controls including sensors unless otherwise agreed with the Electrical Contractor.

The Electrical Sub-Contractor shall include for providing all cable tray containment within the building and cable trunking containment systems within plant rooms for the wiring of controls and power supplies.

The Electrical Sub-Contractor shall allow for designing and installing power supplies to the mechanical equipment using the type and size of cables as required for the specified plant and as detailed by the Mechanical engineer or his controls specialists.

In general, the following shall be designed, supplied and installed by the electrical contractor.

1. Power supplies to all control panels and outstations
2. Containment and wiring to mechanical services control panels and equipment.
3. Containment for controls and sensor wiring (final connection by others)
4. Termination of wiring within control equipment (unless otherwise agreed) to wiring diagrams provided by the controls specialists.

#### **LOCAL HEATING CONTROL CIRCUITS**

To permit the zoning of the heating and to provide local control, the electrical contractor shall allow for wiring of new power and control circuits to each heater location which shall be taken from the local distribution board.

These circuits shall be exclusive radials and contactor controlled so that the BMS is able to control the supplies and electrically shut down the convectors within a defined heating zone as required.

In each space served by a convector, the radial shall terminate in a spur with cable outlet adjacent to each heater.

The contractor may elect to use convectors with integral thermostats or may use dedicated room thermostats which shall be positioned at 1450mm affl.

All remote thermostats where used shall be electronic and tamperproof so that the set point cannot be altered without removing the cover with a tool or by accessing a user code to adjust the set point.

Suitable units shall be those which require temperature setting by internal DIP switches and has no external user adjustment. The contractor may however offer alternative products that meet the requirements.

Note that the electronic thermostats although capable of direct switching small loads are normally only low current rated on the switching relays and therefore may require additional contactors to achieve control of the heating services.

#### **4.07 V40 EMERGENCY LIGHTING**

##### Performance Objectives

To design, provide, install, test, and commission an emergency lighting system to serve the refurbished plant room only as required by Building Control Officers and British Standards.

No other emergency lighting works are envisaged as part of this contract other than the specific areas of the refurbished plant rooms.



The entire design and installation shall be carried out in complete compliance with the requirements of BS5266-10-2008 and all subsequent amendments

The contractor and his designer shall submit calculations and lux plots to demonstrate that the requirements of the BS and this specification are met.

In general, the system shall achieve the following levels:-

- 1 lux on the centre line of all escape routes
- 0.5 lux across the core area of open panic areas

#### System Description

Design supply and install a complete system of emergency lighting to all plant areas as noted above

Illumination levels shall comply with the requirements of BS5266 (Emergency lighting) but shall deliver a minimum of 1 lux along the centre line of an escape route and 0.5 Lux over the core area of open areas.

Emergency lighting shall be provided along all escape routes and to open areas as required.

Specific attention shall be given to any escapes and fire fighting appliances.

Fire fighting appliances and call points shall be illuminated as shall all changes of direction and level and all points of access and egress from the building. This shall include emergency lighting to the external of all final exits and along external escape routes as required to ensure safe exit from the premises.

All fittings used shall be ICEL or equal and appropriate to the area served.

Preference shall be given to the use of LED emergency fittings throughout the installation where not integrated with main lighting.

In general and as far as is reasonably practicable, all emergency lighting shall be integral to the proposed general lighting scheme, but in certain areas, "stand alone" fittings may be required.

All emergency lights shall be wired via secret key operated test points which shall be located within the local switch plates.

Test points shall be labelled "Emergency lighting test point".

The contractor may fit a single test point to control a group of fittings within close proximity of each other e.g. corridor, entrance etc. on condition that all points served by the test point would be fed from the same lighting circuit.

In all areas unless otherwise required by BS5266 or the Building Control Officer, the exit signs and emergency lights shall be non-maintained.

Wiring to all emergency lighting points shall be in LSF cables contained within the general lighting and power containment.

Where luminaires are to be attached to the ceiling grids or tiles, the contractor shall ensure that the ceiling fixer provides adequate reinforcement in these areas.

#### **4.08 W30 DATA TRANSMISSION**

##### Performance Objectives

To design, provide, install, test, and commission modifications to the existing data communications system to serve the plant room area and requirements of the new BMS outstations as necessary using standard Category 5UTP cabling to each point terminated in RJ 45 outlets in each space.

Provide all outlets with a unique identifier to a protocol to be agreed with the Client.

Label all inlets and outlets in the agreed form for ease of identification.

Ensure that in every plant space there is a dual RJ45 outlet at the control panel position.

##### System Description

Provide all data connections as may be required by the Contractors design to connect all BMS/heating control outstations and equipment such that a fully integrated system is achieved which can be remotely accessed and controlled.

Works associated with the data installation shall be carried out by the Contractors specialist unless the Contractor is suitably qualified to carry out and certify the works without infringing any site wide warranties.

The Contractor shall liaise with the Clients IT department in respect of these works.

#### **4.09 W51 EARTHING AND BONDING**

##### Performance Objectives

To design, provide install, test, and commission a complete earthing system such that in the event of an electrical fault, the fault is dissipated to earth via a route of negligible impedance with no danger to life or property.

##### System Description

Design supply and install a system to bond and connect to earth all exposed conductive parts of the electrical installation and all extraneous conductive parts so that in the event of a fault of negligible impedance, disconnection will take place in a manner and in such time as to ensure no danger arises.

Bond all services entering the building as close to the entry point as possible Telecommunication service bonding to be agreed with service provider.

Provide supplementary equipotential bonding to all areas as defined in BS7671

The main earthing system for the building shall make use of the existing earthing arrangements within the existing switchroom and the CPCs shall be run with the new submains shall be suitably bonded to the main earthing terminal in the mains electric cupboard.

All earthing and bonding conductors shall be copper unless otherwise indicated within this E.R Document and schedules.

All submains shall be run with a supplementary CPC. The SWA cable sheath shall not be relied upon as the sole means of earthing.

All SWA sheaths shall be bonded using suitable glands complete with tag washers as defined earlier in this E.R Document. Supplementary CPCs shall be bonded to distribution boards and earthing bars by means of lugs and bolted connections.

All connections shall be clean, paint free and prepared such that a joint of negligible impedance is provided.

#### **4.11 W60 Controls and Monitoring**

##### Performance Parameters

To design and provide a simple and effective control system, which will control the operation of the heating and associated equipment within the Building in conjunction with the Mechanical Services Contractors.

##### System Description

Liaise with the mechanical contractor and provide all wiring, power supplies and containment as may be necessary to serve the control system as set out on the mechanical specification.

Any automatic controls shall be complete with control panel, control contactors, actuators, temperature sensors, and shall be supplied, commissioned and finally set-up as part of the mechanical services package.

A system of controls with optimiser and weather compensation shall be provided.

In respect of the primary mechanical systems, the approximate locations of sensors, detectors, thermostats, and flow switches shall be agreed between the mechanical and electrical contractors and approved by the Clients Agent.

The mechanical contractor who shall be responsible for the correct siting and specification of control items and all necessary equipment required for the operation of the system to provide the automatic control as described.

The electrical contractor shall be responsible for all relevant power, wiring and containment.

Any dedicated services control panels supplied to serve the systems shall incorporate, a door interlocked isolator, all of the contactors, thermal overloads, MCB's, transformers, fascia switches, fascia indication lamps and electrical supplies, for all of the plant and equipment.

The mechanical or specialist contractor shall be responsible for the design, supply, and assembly, testing and commissioning of the automatic controls.

## **5. HEATING AND HOT WATER TECHNICAL REQUIREMENTS**

### **5.01 GENERAL OVERVIEW**

Also see section 4.01

Existing oil fired boiler plant shall be removed in its entirety together with all radiators, pipework and associated plant.

The Mechanical and electrical contractors shall allow for the appointment of a building and decorating contractor to carry out all necessary making good and redecoration of areas damaged as a result of the works being undertaken to remove the redundant services and systems.

As noted elsewhere in this document, if pipework cannot be removed without extensive damage to building fabric, it shall remain in place and be purged and filled with inert material and abandoned.

The contractor shall exercise caution when removing pipework as all pipes associated with the general hot and cold water services shall remain in place and be re-used.

Internally, the areas are set out as indicated on the generic layout drawings and where more fully detailed later in this document.

The building and associated apartments will be heated using new electric heating served from new electrical distribution. It shall use Radiators/convectors and Fan Convectors as required and which shall be fully zoned.

It should be noted that domestic services within the existing building must remain live throughout the Contract and the contractor and his designer shall be aware of this and make all necessary endeavours to protect equipment and associated supplies etc to ensure the continued operation of such equipment.

The tenderer is reminded of the content of Clause 1.2 requiring him to visit the site during the tender period. This is of special relevance in context of mechanical services as a number of existing services are to be either adapted or have connections made to them and only a site survey will allow the tenderer to price the project with accuracy. Any claims for extras by the appointed contractor on the grounds of ignorance of existing site conditions and/or services will be rejected.

### **5.02 S10 COLD WATER SERVICES**

#### Performance Objectives

To provide a complete cold water system which shall be appropriate to serve the buildings domestic cold water demand.

It is envisaged that local cold water supplies shall be retained as existing and re-using the existing water main serving the premises.

Supplies shall be adapted as required to allow for the new hot water arrangements. This is more specific to the separation of the tow apartments from the Mundesley central plant.

New or adapted water supplies will be required to the new Hot water generating plant and associated systems within the apartments.

The design of any new facilities to comply with Building Regulations.

Notify Building Control and Water Authority as required and provide all necessary calculations and assessments as required.

### System Description

Design supply and install a complete cold water system to supply the needs of the refurbished building hot water systems. (See S11)

Disconnect make safe and remove all unnecessary pipework and deadlegs associated with redundant facilities and include new pipework and distribution appropriate to new requirements.

The cold water systems shall be designed in compliance with the current editions of:

- The Water Supply (Water Fittings) Regulations 1999 and The WRAS Water Regulations Guide. The Contractor shall include for liaising with South West Water Regulator to gain consent for the installation of the designed domestic water services. A certificate shall be provided at practical completion to confirm SWW Regulator compliance.
- BS 6700 Specification
- CIBSE Public Health Engineering Guide G.
- CIBSE TM13 and HSE's Approved Code of Practice and Guidance L8 - Legionnaires Disease: The control of legionella bacteria in water systems.
- BS EN 806 - Specifications for Installations Inside Buildings Conveying Water for Human Consumption,

The modified systems shall be in compliance with the relevant Water Regulations and accepted by the Isles of Scilly Council as the relevant Water Authority.

The contractor shall submit the design to the Water Authority as required.

Provide MCWS to all new points of use via cold water distribution pipework run through the ceiling voids and boxings as required.

Any modified pipework shall be run through the ceiling voids however the contractor shall ensure that his working drawings pick up and account for any site specific coordination that may be required.

Pipework is to be copper to BS 2871 Table X with capillary soldered joints

All pipework in ceiling voids, service ducts and risers shall be insulated against heat transfer to BS 5422, the insulation shall be pre-formed sectional fibre glass finished with a bright aluminium foil finish.

In the case of mains cold water pipework insulation, the vapour seal shall be continuous to prevent sweating on exposed sections of pipework. This shall be deemed to include covering of joints and valves with appropriately sized and shaped pre formed sections. Where valves cannot be provided with pre-formed sections, they shall be fitted with insulation jackets secured with lacing to ensure the best possible protection.

All pipework shall be fitted with pipe identification colour bands and direction arrows to BS 1710.

In all plantroom areas and where insulation may be subject to damage during or after the works due to maintenance procedures it shall be clad with aluminium cladding.

Allow for the fitting of ¼ turn isolation valves at all items of sanitary ware, sinks and other water outlets to appliances to allow for future maintenance.

MCWS pipework shall be segregated from HWS and heating pipework and where run in horizontal common boxings, the MCWS shall always be the lowest positioned pipe.

All new piped systems are to be fully chlorinated to BS 6700 and the chlorination certificate to be incorporated in the final Operating & Maintenance manual.

Include for:

- a) Direct connection to all outlets.
- b) Thermal insulation as mineral fibre with factory applied foil finish to all concealed pipework.

If appropriate, the contractor shall install pressure regulating valves to ensure correct operation of mixing valves and sanitary appliances. This shall include maintaining balanced pressures as required to meet manufacturers tolerances.

Supply and fix ballofix or equal quarter turn isolation valves at each terminal device for maintenance isolation.

All pipework shall be:

- laid in continuous lengths with no concealed joints (as far as is reasonably practicable) or flexible hose connectors;
- adequately supported along its length;
- provided with additional supports as necessary adjacent to valve and pump etc positions;
- protected from corrosion and damage.

Where hot & cold water pipework is intended to be exposed, it shall be chrome plated.

#### **5.04 S11 HOT WATER SERVICES**

##### Performance Objectives

To provide a complete hot water system which shall be appropriate to serve the building domestic hot water supply needs.

Works are to be generally confined to design supply and installation of hot water generation and to replace life expired calorifier with new calorifier featuring both solar thermal generation and immersion heaters within the main boarding house.

Within the apartments, the works will consist of disconnecting them from the central circulated hot water system and for providing them with their own dedicated hot water generation.

Where alterations are made to the circulated secondary as a result of removing the apartment feeds, the contractor shall allow for rebalancing the remainder of the system such that circulation and return temperatures are maintained and compliant with Legionella regulations.

If necessary and in accordance with the Contractors design, he may fit additional balancing valves to assist in achieving appropriate circulation through the system. Where used, these shall be thermostatic type with auto purge to permit higher temperatures to flow for system disinfection.

The clauses below are intentionally generic to allow the contractors designer some flexibility in design and procurement of appropriate equipment.

Note that alternative technology options may be considered if the contractor can demonstrate both cost savings and benefits in long term energy use.

Retain existing circulated HWS distribution to all areas and adapt only to suit new calorifier plant as appropriate.

Size the system in accordance with BS6700 where any alterations are required

### System Description

Design Supply, install, test, dose and commission a complete domestic hot water system to deliver hot water to all new user points.

Include for:

- a) Direct connection to all outlets
- b) Thermal insulation as mineral fibre with factory applied foil finish to all concealed pipework.

If appropriate, the contractor shall install pressure regulating valves to ensure correct operation of mixing valves and sanitary appliances. This shall include maintaining balanced pressures as required to meet manufacturers tolerances.

Supply and fix ballofix or equal quarter turn isolation valves at each terminal device for maintenance isolation.

All pipework shall be:

- laid in continuous lengths with no concealed joints (as far as is reasonably practicable) or flexible hose connectors;
- adequately supported along its length;
- provided with additional supports as necessary adjacent to valve and pump etc positions;
- protected from corrosion and damage.

Where hot & cold water pipework is intended to be exposed, it shall be chrome plated.

All hot water services alterations shall be installed using Table X copper tube and capillary fittings.

In all plantroom areas and where insulation may be subject to damage during or after the works due to maintenance procedures it shall be clad with aluminium cladding.

Provide DHWS to all sinks and basins as required by the existing installation.

If appropriate, the contractor shall install pressure regulating valves to ensure correct operation.

The Hot water systems shall be designed in compliance with the current edition of:

- The Water Supply (Water Fittings) Regulations 1999 and The WRAS Water Regulations Guide. The Contractor shall include for liaising with South West Water Regulator to gain consent for the installation of the designed domestic water services. A certificate shall be provided at practical completion to confirm SWW Regulator compliance.
- BS 6700 Specification
- CIBSE Public Health Engineering Guide G.
- CIBSE TM13 and HSE's Approved Code of Practice and Guidance L8 - Legionnaires Disease: The control of legionella bacteria in water systems.
- BS EN 806 - Specifications for Installations Inside Buildings Conveying Water for Human Consumption,

The system shall be in compliance with the relevant water regulation and accepted by the Water Authority.

The contractor shall submit the design to the Water Authority as required.

Pipework is to be copper to BS 2871 Table X with capillary soldered joints

Connect to local DHWS feeds at appropriate locations and distribute to new points of use.

All domestic Hot Water Service pipework is to be insulated to prevent heat transfer.

Insulation shall be preformed rigid glass fibre sectional complete with bright aluminium foil finish with lapped vapour seals in accordance with BS 5422.

Flow arrows and service identification colour bands to BS 1710 are to be fitted upon completion.

### **Calorifier**

Design supply and install a new domestic hot water calorifier to replace the life expired unit within the boarding house.

The calorifier shall be sized in accordance with BS6700 based on demand units and to be suitable for the peak demands and a reasonable recovery time.

The calorifier and its elements shall achieve a recovery time from full depletion to capacity within 2 hours.

The calorifier shall be of Stainless steel construction and shall be vertically mounted. Where appropriate and to achieve the required system capacity, the contractor may elect to use multiple calorifiers or a calorifier and buffer vessel.

Where multiple calorifiers are fitted they shall be installed such that the flows from each are balanced and the load shared equally between the calorifiers.

Where a buffer vessel is used, it shall be configured such that it is circulated and no stratification can take place within the vessel. The buffer shall also share the peak demand of the system.

Where possible and reasonably practicable, the hot water demand for the morning peak period shall be met by use of overnight heating of the cylinders.

During the day after the morning peak period, replenishment and maintenance of temperature within the system shall be by means of solar thermal or other renewable technology and the immersions.

Note that the buffer capacity is likely to be significantly larger than the present calorifier as the boiler power available from the oil system would have given some degree of replenishment as water was drawn off. The electrical immersion and solar input is unlikely to deliver the same degree of input therefore the cylinder capacity must be increased to allow for the depletion and associated recovery time.

### **Solar Thermal Generation**

Design supply and install within the calorifier a solar thermal coil that will be heated from roof mounted solar collectors to provide heat input to the cylinder and/or buffer vessel.

Solar collectors shall be high efficiency evacuated tube type and shall be mounted on the flat roof above the dormitory block. The orientation and elevation of these collectors shall be such that maximum benefit is gained from any available solar input.

Note that the collectors may not protrude any higher than 1m from the roof level or be closer than 1m from the edge of the roof. The design shall take account of this so as not to infringe permitted development rules on the islands.

Within the plant room the contractor shall design supply and install a solar thermal pump station and all associated controls to serve the calorifier and collectors.

The system shall be filled with a Glycol mix or as required by the manufacturers and installers.



The contractor shall ensure that the selected cylinder is fully compatible with the solar thermal system, in terms of coil input and material of manufacture.

The solar thermal system shall be integrated with the immersions such that there is an inhibit connection that will hold off the immersions if there is sufficient solar gain to reheat or maintain the calorifier temperature.

All Solar thermal equipment shall be installed totally in accordance with the manufacturers recommendations and relevant British Standards.

### **Apartment Hot water generation**

Within the two apartments, the contractor shall design supply and install local water heating.

Disconnect existing circulated hot water at the entry point into each apartment from the central plant and arrange pipework such that the existing circulation through the remainder of the boarding house is maintained. This work may require some rebalancing of the existing secondary returns (see above).

Within the apartments, the contractor shall design supply and install the following:-

#### *Flat 1 Ground Floor*

*This apartment has its own electric meter and supply, it has a shower cubicle with an existing electric shower. The bathroom sink and kitchen sink hot water are fed from the existing central system which shall be disconnected.*

Allow for design supply and installation of a small immersion heater with cylinder or under sink water heater to supply the sink and WHB with hot water.

#### *Flat 3 First Floor*

*This apartment has its own electric meter and supply. It has a bath with a shower head attachment on the bath taps that draws from the communal system. The kitchen taps and bath taps also use the central system which shall be removed.*

Allow for design, supply and installation of an over bath electric shower rated at 8kW with a cold water feed taken from the local cold water supply. Install the shower over the bath in an agreed location in accordance with manufacturers recommendations.

Provide this shower with all relevant controls including a pull cord with visual indicator, isolators and safety equipment as required by BS7671 and feed from the apartment distribution board via a suitably sized breaker and RCD.

To serve the bath taps, WHB and kitchen taps, design supply and install a local mains fed immersion cylinder as Megaflo or equal. A location may be agreed at design stage but as the bathroom is of reasonably size, it is envisaged that the new cylinder may be fitted in this location and provided with a cupboard with shelving above. The contractor shall liaise with his selected building contractor to accommodate this work.

The Megaflo shall take its cold feed from the local water supply and be installed totally in accordance with manufacturers recommendations.

The unit shall be fitted with an immersion heater which shall be served from the flat distribution board via a suitably sized breaker and a time clock to allow time periods to be programmed as required by the occupants.

The time controls shall be located adjacent to the water cylinder.

## 5.05 T20 PRIMARY SPACE HEATING

### Performance Objective

To provide a new heating distribution system which shall be appropriate to serve the building heating requirements via simple and effective electric radiator heating or convectors sized to meet the heat losses of the space served

The system shall maintain the internal temperatures as set out in the Schedule of Common Design Criteria within this specification.

The Contractor shall carry out heat loss calculations on the building to assess the heating load taking account of the building fabric U values, vent and infiltration losses.

The heating emitters shall be tailored to the thermal losses of each space individually.

### System Description

The heating systems shall be designed in compliance with the current edition of:

- CIBSE Design Guides A, B & C
- Building Regulations Part L

The heating is to be provided by electrically powered emitters with power derived from main and sub distribution.

The distribution shall be arranged so that the circuits can feed the building but with capacity to allow more modules to be added later.

The following shall occur as part of the scheme:-

- Design, supply and install a fully zoned system within the new building that takes account of the space usage, orientation, level and solar gains such that the system runs efficiently.
- Separate the heating serving the rear apartments and re-serve them with electric heating fed from their own local supplies.
- Supply and install main and sub distribution as required to provide the required power to serve the building heating.
- Arrange the distribution and circuiting as required to serve the desired zoning
- Balance all heating across the three phase power supply such that each phase is equally loaded as far as is reasonably practicable.
- Control each space with local thermostat which may be integrated within the heater or separate as noted above.
- Control each zone with zone thermostat and BMS control with space temperature detection as required.
- Electrically control fan convectors in each zone if so required by the Contractors design

The system shall be weather compensated.

### **RADIATOR/CONVECTOR HEATING**

The contractor shall supply and install radiator/convector heating to serve the building.

All circuits serving radiators are to be fed from new controlled zones.

Existing LTHW radiator locations are suitable for the new scheme and shall be used as far as is reasonably practicable following strip out of the redundant heating scheme.

Where existing fan convectors are used, the same theme shall be followed unless the contractor can prove that sufficient heat input and distribution can be achieved with passive radiators/convectors.

All radiators/convectors shall be fitted with Thermostatic Control which shall be lockable and tamperproof.

All radiators/convectors/fan convectors shall be from a reputable manufacturer with good spares availability.

The contractor shall list his proposed manufacturers within his tender return.

All of the heaters shall be fitted with overheat cutouts and safety circuits such that if the heater is covered or otherwise restricted in air flow, the power will be disconnected and the unit permitted to cool.

All shall be from the Low Surface Temperature ranges and shall be touch safe to prevent scalding. Heaters that cannot achieve this shall not be used.

Where there is the possibility of water/dampness such as bathrooms, consideration shall be given to the use of fixed oil filled radiators mounted on wall brackets which shall be of high quality and suitably IP rated.

Traditional convectors shall not be used in these locations.

The contractor may submit alternatives but they shall be of equal quality to the specified ranges and shall only be used with approval by the Client and their representatives.

#### **FAN CONVECTORS (WHERE REQUIRED)**

All new fan convectors where required by the contractors design shall be as follows and this specification shall not be changed without prior agreement:-

- Heaters to have integral return air thermostat or remote thermostat as required by the Contractors Design
- Heaters to have high temperature cutout to isolate heating elements when no heat present in the pipework
- Heaters shall be sized to deliver the required heat output for each space when running at low setting to minimise case temperatures. In larger spaces 2 heaters may be provided with each unit being capable of delivering 60% of the required duty. This is to ensure adequate heat distribution around the space.
- Access panel for controls to be lockable.

#### **HEATING ZONING**

The whole system shall be fully zoned to take account of building orientation and differing heat gains/losses.

The new zoning shall be as follows:-

##### *Dormitory block*

Feed as a dedicated zone with sub-zone for ground and first floors. The first floor is known to be warmer and the heating to this area shall be capable of being isolated individually from the ground floor.

Control locally in each room and with a zone sensor in the coldest space.

*Common areas in old building*

Feed as a dedicated zone with control local to the rooms and by a zone sensor located in the coldest space.

*House Parents flat*

Feed as a dedicated zone with control local to the rooms and by a zone sensor located in the coldest space.

**ZONE CONTROL**

Zones shall be controlled by contactors switching the zone DBs or individual circuits controlled by the BMS. The zones shall operate as required to deliver heat into each space and shall be under the control of local zone control sensors that will transmit the space temperature back to the BMS. The system will be set such that the zone is fully shut down only when all spaces within the zone are up to temperature.

Any zone calling for heat shall cause the respective zone controller to activate as required to deliver the required heat input.

**5.07 W60 CONTROLS AND ELECTRICAL WORK IN ASSOCIATION**

This section of the mechanical Employers Requirements shall be read in conjunction with section W60 of the electrical Employers Requirements.

The Contractor shall design, supply install, commission and set to work a complete BMS control system that will control all items of plant installed or modified as part of the contract works.

The mechanical and electrical services systems shall all be time and temperature controlled from a central control panel located in the plant room.

This panel shall be a completely new unit and will control all plant and systems. This shall be deemed to include but not be limited to the existing:-

- Electric heating
- Zone controls
- Hot Water Generators
- Ventilation

The controls shall be based around a simple open protocol BMS system allowing interfaces to other existing systems should the need arise.

The controller will be equipped with a touch screen interface located on the main control panel within the plant room. The touch screen interface will permit password protected user access to all normal control functions and set points with the higher level engineering functions locked behind a second password protected page.

The controllers shall be given a fixed IP address and connected to the data network such that all control functions can be accessed remotely from the Estates office PC via an inbuilt web engine.

### **Control Panel / BMS Outstations**

The control panel / outstation shall be designed and built by a control specialist and shall comply in general with the details given in this document.

The control specialist shall issue working drawings and fully numbered interconnection diagrams to enable an electrical contractor to make all interconnections between the control panel, plant and sensors.

The control panel shall deliver power supplies to all control contactors, existing mechanical services plant and systems and will monitor plant condition and other parameters such as room temperature, external temperature.

All terminals shall be numbered in accordance with the panel wiring diagram.

No plant or sensors shall be directly connected to the mother board or modules thus bypassing the main terminal strip.

All wiring within the control panel / outstation shall be easily identifiable by the use of wire and terminal numbers.

All cables shall be marked at both ends within the panel.

All cables to be tri rated to BS 6231

Outgoing wiring from the terminal strip shall be fitted with terminal numbers at the panel and remote ends such that they can be easily identified during testing and commissioning.

Wiring within the control panel to be contained within suitable trunking with access slots. (eg Critchley Betaduct)

Volt free contacts shall be provided for all items of plant to enable alarm/status signals to be sent to the B.M.S.

### **Panel Installation**

The electrical contractor shall be responsible for the fixing and connection of the control panel and shall ensure that the control system is protected during installation.

The electrical contractor shall remove all gland plates and panel entries for drilling and slotting for cable entries. He shall not drill gland plates with the control equipment in place unless suitable precautions have been taken to prevent the ingress of swarf and filings into the contactors/relays etc.

The contractor shall ensure that the trunking/conduit connection to the panel is of sufficient width such that only the removable gland plate needs to be perforated.

Any stray swarf or filings found within the panel after installation shall be cleaned out with a vacuum cleaner.

Any damage to equipment within the panel which can be attributed to the ingress or swarf and filings shall be rectified at the expense of the installer.

### **Remote Relays / control contactors**

Remote relays used to drive equipment not located within the boiler house shall in general be a low voltage type capable of being driven directly by the digital output from the B.M.S or through a relay located within the control panel.

If the output from the B.M.S is of insufficient capacity to drive the number of relays required, a suitable transformer shall be fitted within the control panel to provide a low voltage supply for these relays/contactors.

The remote relays must be wired such that they are energised to switch off the plant they control. For this reason, if they are controlled by a LV transformer and relay within the panel, the control specialist shall ensure that the system is capable of providing the required output.

This is required so that in the event of a control system failure, all plant will run.

### **Sensor and Control Wiring**

The Zone sensors shall be wired in the type of cable as specified by the manufacturer but generally to BS5308.

This cable shall physically isolated from mains wiring.

Immersion sensors and outside sensors shall be wired in data cable to B.M.S outstations via the terminal strip in the control panel.

Connection from the BMS to immersion and duct sensors shall be in "Kopex" or equal and approved with the data cable drawn through.

Connections to pressure switches etc shall be made as detailed for sensors.

Where room sensors are fitted to back boxes or other outlets, the end of the conduit or back plate of the sensor shall be sealed with a suitable non setting compound to prevent the ingress of air and draughts from areas external to the controlled space.

Sensors and thermostats shall be mounted at 1650mm above finished floor level.

Spur for the Fan convectors shall be mounted at a level to suit the mounting height of the fan convector.

### **Primary control functions**

The panels shall deliver power and control functions to the following items as a minimum but the actual system and control points will depend upon the contractors design.:-

- External temperature.
- Internal temperature (per zone and sub zone as applicable)
- HWS Flow temperatures
- HWS Return temperatures.
- Heating zone drives
- Pump drives (HWS Secondary Circulation only)
- Pump tripped
- Pressure faults

The panels shall be as located within the plant rooms and be complete with Hand/Off Auto switches for the heating and pumps which will also be complete with run (green) and trip (red) indicators. Indicators shall be low power LED type and a single two colour LED may be used provided the meaning of the various colours is made clear on the panel fascia.

The panel shall also be complete with control circuit healthy (green) and control circuit failure (red) indication, in addition a lamp test button shall be provided on the panel fascia to test all lamps.

All outgoing power circuits shall be protected with suitably rated protective devices and connections to field wiring shall be made by a numbered Klippon terminal rail. Fused Klippon terminals will not be accepted.

An alarm integrator shall be included to collect and deliver any trip or fault conditions from any of the new mechanical services. This unit shall take the form of a single red indicator lamp in an engraved single gang size front plate with an engraved legend to read "plant fault" or otherwise as appropriate.

It shall be located adjacent to the main entrance internally such that any fault is made immediately apparent to the site staff.

The system will be time controlled and programmed to suit the year timetable of the hostel.

The timetable will run all plant as required to heat the spaces to the required occupancy temperatures at the start of each day and shall shut the system down at the end of the day. The system shall operate in both optimum start and stop modes so that the plant is only run when required to bring the hostel up to temperature and maintain this till the end of occupancy.

Facility shall be provided on the control panel to programme a timed extension to run the heating and hot water plant outside of normal hours. This shall take the form of a 5 hour run back timer and a series of switches to enable selection of each zone as required. It shall also be possible to programme these extensions remotely via the IP Addressed outstations.

A building frost protection function will override all timed functions such that if the space temperature falls below 5°C at any time the mechanical plant will operate in full until a room set point of 12°C has been achieved.

A mains supply will be brought into the new control panel by others under the electrical contract but all site wiring from the new panel to field mounted devices such as damper motors, sensors, drive motors etc are to be undertaken by the mechanical contractor as part of this works package. All site wiring is to comply with BS 7671.

The tenderer is to be aware that the age of the existing buildings will be such that the colour codes of the existing cabling will be different to the current standards.

**6. APPENDIX A – GENERIC WORKMANSHIP CLAUSES**

**Electrical.**

V20 LV Distribution  
V22 General Power  
V40 Emergency Lighting  
W51 Earthing and Bonding  
Y81 Testing and Commissioning of Electrical Services

**Heating**

S10 Cold Water  
S11 Hot Water  
T15 Solar Water Heating  
Y23 Storage cylinders and calorifiers  
Y51 Testing and Commissioning of Mechanical Services



### 1. PERFORMANCE OBJECTIVES

To provide the distribution of low voltage electricity from the building main switchgear panel to and including the area distribution boards, sub-distribution board, motor control centres and specific items of mechanical plant.

To provide three phase power supplies to user points.

### 2. SPECIFICATION CLAUSES SPECIFIC TO V20

### 3. PRODUCTS/MATERIALS

### 4. SWITCHBOARDS, DISTRIBUTION BOARDS

Refer to Y71

### 5. CABLES and SUPPORTS

Refer to Y61 and Y63

### 6. EARTHING

Refer to W51

### 7. BUSBAR TRUNKING

Refer to Y62

### 8. CO-ORDINATION STUDY

Carry out a complete protection grading and setting calculation of the complete electrical distribution system, including all connected equipment. Engage an independent Chartered Electrical Engineer to: Undertake and verify the calculation.

Provide fault (short circuit) calculations for the distribution system as indicated on the drawings and a protective device co-ordination study to ensure that all protective devices are co-ordinated, to achieve full discrimination (unless specified otherwise). Base the study on the actual devices and cable lengths installed.

Prepare the fault calculations in accordance with BS EN 60909 and protective device study with an approved proprietary software package, by prior approval written calculations may be used for simple networks, include complete fault calculations for each proposed source and combinations thereof including motor, generator and UPS contributions.

Present the fault calculations including the following:

- General description of calculations methods, assumptions and base per unit quantities selected.

- Evaluation of grading margins used.

- Single line diagrams, source and electrical equipment characteristics (impedance data including X/R ratios, zero sequence impedances, inrush current characteristics, rated currents, design loads).

- Calculation of peak and three phase symmetrical / asymmetrical prospective fault currents (short circuit and earth fault) at each switchboard, motor control centre and distribution board.

- Typical calculations, tabulations of calculation quantities and results, verification of electrical equipment fault ratings.

- Conclusions and recommendations

Carry out the protective device co-ordination study including the following:

- Carry out adjustments of the protection settings to confirm that the requirements of the report, ensure that;

- total discrimination is achieved throughout the network and select protective devices and settings accordingly.

- electrical equipment is protected.
- maximum disconnection times are achieved.

Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graphs for short circuit and earth fault conditions. Include on each sheet, a complete title and single line diagram identifying the specific portion of the system covered.

A detailed description of each protective device identifying its type, function, manufacturer and time current characteristics.

Tabulation of recommended settings and operating values for each function of each device.

Include on the graphs, relay characteristics, pertinent transformer, motor and generator characteristics from the downstream HV device and including up to the largest outgoing LV circuit breaker/fuse for each final distribution board. Indicate manufacturing tolerances clearly showing the final grading margin. Submit the study as a bound report for approval by the CA. Upon approval by the CA, submit copies of the approved report together with soft copies of the project fault level calculations and discrimination study files in the approved software native format.

### **9. WORKMANSHIP**

### **10. INSTALLATION:**

Install equipment in accordance with manufacturer's recommendations.

### **11. TESTING and COMMISSIONING**

Refer to Y81

### 1. PERFORMANCE OBJECTIVES

To provide sub-circuit power installations from the sub-distribution boards terminating with socket outlets, fuse connection units and other outlet accessories.

### 2. DESIGN PARAMETERS

#### 3.

Unless otherwise indicated all final circuits for general LV power circuits shall comprise:

Circuit type	MCB	Protective device and rating (A)					
		20A		32A		20A	
		Ring				Radial	
Cable size (mm <sup>2</sup> )		2.5	4.0	2.5	4.0	2.5	4.0 6.0
Maximum circuit length (metres)		35	60	20	35	25	40 60

(Cable sizes are based upon a maximum volt drop of 2% with the circuit loaded to 50% of the cpd rating. For ring circuits a 0.67 current diversity has been used.)

Circuit lengths are taken to the furthest point of utilisation of the circuit for radial circuits or for the route length of the circuit for ring circuits.

### 4. SPECIFICATION CLAUSES SPECIFIC TO V22

#### GENERAL

##### 3.1. SYSTEM REQUIREMENTS

Select equipment suitable to meet system objectives and as indicated on the drawings and schedules.

##### 3.2. ELECTROMAGNETIC COMPATIBILITY

Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

#### PRODUCTS/MATERIALS

##### 3.3. WIRING AND CONTAINMENT SYSTEM

Wiring to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.

Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

##### 3.4. POWER USING EQUIPMENT AND FIXTURES

Provide equipment as scheduled complete with means of fixing or supporting.

##### 3.5. POWER TO MECHANICAL PLANT

Provide fused connection unit adjacent to each item of local plant that is not fed from an MCC, final connection to be by the Controls Specialist.

Provide power to all MCC's, distribution boards etc supplied by the Controls Specialist.

### 5. WORKMANSHIP

#### 4.1. WORK ON SITE:

Ensure all building works are complete and service connections provided.

### **4.2. INSTALLATION:**

Install, commission and to set to work equipment in accordance with manufacturer's recommendations and BS 7671.

### **4.3. QUALITY CONTROL:**

Handle ,store and install equipment and components in accordance with manufacturers recommendations. Obtain all equipment and components from a single source.

Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

## 1. PERFORMANCE OBJECTIVES

To provide temporary illumination to escape routes, walkways, selected areas and signs by means of separate lighting systems in the event of failure of the normal lighting systems.

## 2. DESIGN PARAMETERS

Minimum lighting level to conform to the requirements of BS 5266 and BS EN 50172.

Maintain specified lighting level for a period of 3 hours without the use of mains electricity

Unless otherwise indicated all final lighting circuits shall comprise

	Protective device and rating (A)					
	MCB	10			16	
Cable size (mm <sup>2</sup> )		1.5	2.5	4.0	1.5	2.5 4.0
Maximum circuit length (metres)		20	30	50	10	20 30

Circuit lengths are taken to the furthest point of utilisation of the circuit, plus the length of switch lines.

### 2.1. CONTROL REQUIREMENTS

Provide all emergency lighting circuits with local test key switch.

Emergency lamps to energise on failure of local lighting circuit unless otherwise stated.

## 3. SPECIFICATION CLAUSES SPECIFIC TO V40

### 3.1. EMERGENCY LIGHTING SYSTEM:

Standard -BS 5266, BS EN 1838, ICEL 1003, ICEL 1009, BS EN 50171, BS EN 50172 and Local Authorities requirements.

### 3.2. ILLUMINATION OF SIGNS:

Illuminate exit, emergency exit and escape route signs so that they are legible at all times, by lamps external to sign or lamps contained within sign as indicated on the drawings.

## PRODUCTS/MATERIALS

### 3.3. LAMPS FOR EMERGENCY LIGHTING:

As indicated on the drawings and schedules.

### 3.4. SELF-CONTAINED EMERGENCY LUMINAIRE SYSTEM AND EQUIPMENT

Standard ICEL 1003

Provide green LCD luminaire healthy and red LCD luminaire fault (where specified) indicator in accordance with BS EN 60598-2-22 and BS EN 60073.

### 3.5. LOW MOUNTED WAY GUIDANCE SYSTEMS FOR EMERGENCY USE

Standard BS 5266 Parts 2 and 5

### 3.6. OPTICAL FIBRE EMERGENCY LIGHTING SYSTEM

Standard BS 5266 Part 4

### 3.7. CENTRAL BATTERY EQUIPMENT:

Standard BS EN 50171 and ICEL 1009

As indicated on the drawings and schedules.

### **3.8. ANCILLARIES:**

Provide ancillaries in accordance with the appropriate standards and regulatory authority requirements.

## **4. WORKMANSHIP**

### **4.1. INSTALLATION:**

Install, test and commission emergency lighting system in accordance with BS 5266 Part 1 and ICEL 1003.

### **4.2. REMOTE BATTERY AND INDICATOR CONNECTIONS**

Where batteries are located remote from the luminaire the interconnecting wiring shall be fire-rated in accordance with BS 5266 Pt 1

### **4.3. SELF-CONTAINED LUMINAIRES:**

Ensure self-contained luminaires are not installed where temperatures are likely to exceed manufacturers recommended maximum.

Ensure fluorescent luminaires are not used at temperatures below that specified by manufacturer.

### **4.4. EQUIPMENT:**

Install equipment in accordance with manufacturer's recommendations.

## 1. PERFORMANCE OBJECTIVES

To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.

## 2. DESIGN PARAMETERS

## 3. SPECIFICATION CLAUSES SPECIFIC TO W51

### 3.1. STANDARDS

Carry out electrical system earthing work in accordance with BS 7671 (IEE Wiring Regulations) and BS 7430, Electrical Safety, Quality and Continuity Regulations and Distribution Network Operator requirements as appropriate.

- Comply with the requirements of BS EN 50310.

### 3.2. PME INSTALLATIONS:

Provide protective conductors for TN-C-S (PME) Systems where specified

### 3.3. EXISTING INSTALLATIONS:

Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS 7671 (IEE Regulations) before connecting new or modified installations to existing supply.

### 3.4. SOIL TESTS:

Where specified carry out soil tests in accordance with BS 1377 to establish soil electrical resistivity and soil analysis as required.

### 3.5. RISE IN POTENTIAL IN TELECOMMUNICATIONS CIRCUITS:

Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as BS 6701, to 430V or 650V as appropriate.

### 3.6. EXCHANGE OF INFORMATION:

Consult with the electricity supply company regarding the earthing arrangements of the installation. Construct the earthing system to the requirements of electricity supply company. Ensure any part of the earth fault current path provided by the electricity supply company or others is suitable for the operation of the earth fault protection to be installed. Obtain the agreement and permission of undertakings providing services which are to be bonded to the earthing system.

### 3.7. EARTH FAULT RELAYS:

Ensure system compatible with earth fault relays on electrical system as specified elsewhere.

## PRODUCTS AND MATERIALS

### 3.8. CLEAN EARTH DISTRIBUTION (Also Y80 3010)

Install clean earth distribution in double insulated cables from earth electrodes to equipment points. Mount all busbars with insulators and separately from other earthing systems.

### 3.9. MAIN EARTH TERMINAL:

Provide earth bar at incoming electrical service position, for each switchboard.

Bond earth terminals and metallic structure of switch and control gear and plant.

Connect each earth terminal to all other earth terminals by a ring conductor sized as BS 7430 and BS 7671.

Location

	Adjacent to main switch panel.
Mounting	Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.
Material	Manufacture earth busbars from hard drawn, high conductivity copper bar.
Substation Earth busbar	75 x 13mm cross section 600mm minimum length.
Building Earth bar	25 x 6 mm minimum for incoming live conductor not exceeding 50mm <sup>2</sup> and 50 x 6 mm minimum for incoming live conductor over 50mm <sup>2</sup> . Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.

### 3.10. MAIN EARTH TERMINAL CONNECTIONS:

Connect separately each main earth conductor and main equipotential bonding conductor to main earth terminals.

Terminate circuit protective conductors on switchboard earthing bar.

Terminate conductors with compression type lugs suitable for bolting direct to bar or solder lugs suitable for bolting direct to bar

Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable or

When main cable is provided by electrical supply Company, extend separate protective conductor from Main Cable armouring gland or direct earth terminals or PME earth installed by supply Company to main earth terminal.

Provide terminations on each Substation main earth bar as appropriate for

HV Switchgear frame earth (bare copper tape).

LV Switchgear frame earth (bare copper tape).

Transformer frame earths (bare copper tape).

Transformer neutral earths (insulated copper cable).

LV Switchboard neutral busbars (insulated copper cable).

Earthing conductor to minimum 2 groups of electrodes.

### 3.11. NEUTRAL/EARTH CONNECTION:

Provide earth leakage protection system and position neutral/earth connection at main switchboard unless otherwise indicated.

### 3.12. CLEAN EARTH BAR:

Where specified provide clean earth bar.

Mounting

Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.

Material

Manufacture earth busbars from hard drawn, high conductivity copper bar.

Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.

Terminations

Connect each conductor and tape separately to earth bar.

### 3.13. TRANSFORMER OR GENERATOR EARTH ELECTRODE SYSTEMS:

Provide separate electrode systems which each achieve a target resistance of 10Ω (but not exceeding 20Ω), with separate main earthing conductors for each transformer or generator, and an



additional spare electrode system for test purposes. Where a common hv/lv earthing system is provided, the combined earth resistance shall not exceed  $1\Omega$  and the rise in earth potential after an hv earth fault shall not exceed 430V rms or in the case of very short duration faults of less than 0.2s, it does not exceed 650V rms in accordance with BS 7430 and IEC 61936-1. Bond all electrode systems together using a ring conductor. Connect electrode systems to ring conductor via links or disconnecting joints for test purposes.

### **3.14. FRAME EARTH LEAKAGE:**

Where frame earth leakage devices are used for phase to earth protection, connect two earthing conductors as BS 7430, one to the framework of the switchgear and main earth bar via current transformer or other devices, the other to cable sheaths and earthing devices, insulated where necessary.

### **3.15. PORTABLE EARTH CONNECTIONS:**

Provide tape loops for the connection of portable earths where appropriate

### **3.16. SAFETY EARTHING:**

Provide safety earthing in accordance with BS 7430, BS 6423 and BS 6626 where indicated.

### **3.17. TELECOMMUNICATIONS FUNCTIONAL EARTH:**

Provide functional earth in accordance with BS 6701 and BS 7430.

All cables shall be cream and labelled with telecommunication functional earth.

### **3.18. CONDUCTORS:**

Use earthing conductor-Minimum dimension to BS 7430, BS EN 50164-2 Table 1

Current density  $50\text{A/mm}^2$ .

Form Strip generally or rod.

Stranded conductor where appropriate

Material

Copper

Use Aluminium only where agreed with Contract Administrator

Coverings

Generally none.

Use LSOH or where thermoplastic wiring systems are employed PVC may be used. Colour as indicated where specified

Accessories

Use proprietary cast gun metal accessories, fixings, clamps and couplings with phosphor-bronze bolts, nuts and washers. Use adhesive fixings only when approved by Contract Administrator.

### **3.19. CONDUCTOR JOINTS: (Y80 2020,3040)**

Provide waterproof protection at joints subject to moisture.

Joint copper tapes by

tinning before assembly and riveting with two minimum copper rivets. Overlap straight joints by length equivalent to twice (minimum) tape width. Overlap both sides of main tape at tee joints or

naval brass bolts or copper rivets (two minimum) and sweat solid whole joint or

Brazing, using zinc-free brazing metal with melting point at least  $600^\circ\text{C}$  or

Thermic welding or

Cold pressure welding.

Joint aluminium tapes by

Welding to BS EN 1011-4

Joint circular rods as tapes using through coupler.

Joint stranded conductors with compression joints to BS 4579.

For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.

Use phosphor bronze bolts, nuts and washers to make connections between conductors and equipment

### **3.20. TAPE FIXING DEVICES:**

Secure bare copper tape to structure with corrosion resistant proprietary fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure. Space fixings at 450 mm maximum centres for vertical conductors, 1,000mm for horizontal.

### **3.21. EARTH ELECTRODES:**

Standard - BS 7430

Material, minimum size as BS 7430, BS EN 50164-2

Rods Use high tensile strength steel cored molecularly bonded copper sheathed rods with threads rolled on to rods. Sheath thickness 0.25mm (minimum).

Rod Diameter - 15 mm – nominal

Earth electrode couplings

Use silicon bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling.

Use high strength driving cap in contact with driven rod.

Strip.

Stranded conductor.

Plates - Proprietary item.

Earth electrode tape

Interconnect electrodes using bare copper tape or stranded copper cables.

Location

Locate electrodes not less than 2m distant from building/structure protected, and away from telecommunication and pilot cables and metallic fences.

Barriers

Provide permanent non-conducting barriers to BS 7430 at 2m radius around any electrode liable to produce a voltage gradient of more than,  
(V/m) as indicated.

Driving

Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30° to horizontal).

Depth of rod

2.4m (2 x 1.2) minimum below finished ground surface.

Depth of Electrode heads

Locate electrode heads just below ground level.

Spacing

Where electrodes are installed in a group ensure minimum distance between electrodes is twice depth of rods. Where rods for 'clean' earth are installed ensure distance from any other system rods is six times depth of 'clean' rods.

Tape Depth

Install interconnecting or electrode tape 750mm below finished ground level or as ground conditions allow, rising vertically at each electrode.

Connect groups of electrodes to main earth conductor via bolted link in inspection pit as BS 7430 for test purposes.

Earth electrodes in draw pits

Provide concrete cover, permanently labelled, for electrodes installed through cable draw pit bases

Main earth conductor cover tiles

Provide plastic identification tape over complete external lengths of main earth conductors.

Permanent test electrodes

Provide permanently located test electrodes where indicated

### **3.22. SOIL CONDITIONING AGENT**

Provide soil conditioning agent in accordance with BS EN 50164-7 only where design indicates necessary

Conditioning agent to be suitable for application.

### **3.23. EARTH ELECTRODES FOR CATHODICALLY PROTECTED STRUCTURES:**

Provide earth electrode for cathodically protected structures to BS 7430, BS 7361 Part 1 and BS EN 13636 as indicated.

### **3.24. EARTH ELECTRODE CLAMPS: (Y80 2060)**

Connect conductor to electrode head using heavy duty purpose made silicon aluminium bronze body connector clamps or leaded gunmetal body connector clamps, and high tensile phosphor bronze bolts.

- Standard BS EN 12163

### **3.25. EARTH ELECTRODE INSPECTION FACILITIES: (Y80 2070, 2080)**

Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top of removable inspection cover is flush with finished ground or floor level. For internal locations where the electrode passes through water retaining structure provide puddle flange and sealing gland to BS EN 50164-5 suitable for anticipated water pressure, to prevent moisture penetration and duct from enclosure to adjacent wall for conductor. Ensure enclosure provides adequate access for testing purposes. Inscribe cover with legend 'EARTH'.

Provide pit details for builder's work.

After installation of electrode drain all water from pit.

Use concrete, galvanised steel embedded in concrete or polycarbonate as indicated on drawings. Cover to suitable for anticipated loading and to accept finish, where applicable.

### **3.26. BUILDING ELEMENTS:**

Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

### **3.27. CIRCUIT PROTECTIVE CONDUCTORS: (Y80 2110)**

Material as appropriate

Insulated cable

Use LS0H insulated single core cables or

PVC single core cables (where thermoplastic wiring systems are employed)

XLPE Single core to BS 7211.

Metallic screwed conduits (excluding flexible).

Metallic trunking with tinned copper links.

Armouring and/or metallic sheathing of armoured cables.

Armouring of armoured cables where armouring includes copper strands to improve earth conductance.

Integral conductor of multi-core cable.

Size Provide protective conductors sized in accordance with BS 7671 (IEE Regulations) 543.1.4 and Table 54.7 or as indicated.

### **3.28. EARTHING CLAMPS:**

Use clamps complying with BS 951, for bonding pipes and lead sheathed cables.

### **3.29. TEST LINKS: (Y80 2140)**

Provide two test links, in connections between main earth conductors and earth busbar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators

matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

### **3.30. LUGS/TAGS: (Y80 2150)**

Provide lugs or tags to enable connection of bonding conductors to equipment earth terminals.

### **3.31. PROTECTIVE CABLE TERMINATIONS: (Y80 2160, 3030 and 3040)**

For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.

Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices or phosphor bronze bolts, nuts and washers where connections are liable to corrosion.

Provide waterproof protection at joints subject to moisture. Joint stranded conductors with compression joints to BS 4579.

### **3.32. MAIN EARTH CONDUCTOR – WARNING TAPES: (Y80 2180)**

Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.

## **4. WORKMANSHIP**

### **4.1. INSTALLATION OF EARTHING SYSTEM:**

Carry out installation of earthing system in accordance with BS 7671 (IEE Regulations) and BS 7430.

### **4.2. DISSIMILAR METALS: (Y80 3020)**

Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 8 when bonding dissimilar materials.

### **4.3. WORK ON SITE:**

Ensure that all building works are completed and service connections are provided,

### **4.4. QUALITY CONTROL:**

Handle, store and install all equipment and components of the earthing system in accordance with the manufacturers recommendations.

Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.

Test and commission the system in accordance with BS 7430 and BS 7671 and as specified. Record all test measurements.

### **4.5. MAIN AND SUPPLEMENTARY PROTECTIVE BONDING:**

Bond in accordance with BS 7430 and BS 7671 to main earth terminal all extraneous-conductive parts of the installation.

Ensure that any of the following services are bonded for each building or equipotential zone:-

- Water installation pipes.

- Gas installation pipes.

- Fuel oil installation pipes.

- Air ductlines.

- Heating pipework.

- Chilled water pipework.

- Exposed metallic structural parts of the building.

Lightning protection systems

The metallic sheath of telecommunications cables entering the building.

Connection of the lightning protection system to the protective equipotential bonding system shall be made in accordance with BS EN 62305.

The consent of the owner / operator of telecommunications services shall be obtained prior to making connections to metallic sheaths of cables.

In locations that supplementary equipotential bonding is specified bond all simultaneous accessible exposed-conductive-parts of fixed equipment and extraneous-conductive-parts in accordance with BS 7671 Section 544.2 and 705.54 as applicable.

Extraneous-conductive-parts may be used as supplementary bonding conductors where they satisfy BS 7671 Regulation 543.2.6

Use strip or stranded conductor as appropriate.

Use clamps to BS 951 for bonding of pipes.

#### **4.6. HIGH VOLTAGE CABLE SHEATHS AND ARMOUR:**

Bond the sheaths and armour of high voltage cables solidly to earth, at both ends unless otherwise indicated.

#### **4.7. LOW VOLTAGE SHEATHS AND ARMOUR:**

Bond the sheaths and armour of low voltage cables solidly to earth at both ends unless otherwise indicated.

#### **4.8. METALLIC FENCING:**

Bond to earth any metallic fencing enclosing earth electrical system in accordance with BS 7430.

#### **4.9. IDENTIFICATION:**

Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors.

Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors. Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor.

Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.

Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts.

#### **4.10. GENERATORS:**

Provide separate earth electrode system, completely independent of supply earth system where incoming supply is not derived from Consumer's own transformers.

Connect star point of generator to earth electrode system as generator manufacturers recommendations and to BS 7430.

Bond generator star point and metal framework to Local Electricity Supply Company earthing point.

#### **4.11. EARTHING OF MOBILE GENERATOR:**

Bond the generator frame, all exposed metalwork, underframe or chassis and all protective conductors, to BS 7430, to form common reference point. Connect generator star point to this

common reference. Provide a separate connection from this reference to the load by a fifth cable core or separate single cable.

### **4.12. HIGH VOLTAGE SYSTEM EARTHING:**

Install HV system earthing to BS 7430. Connect all exposed conductive parts of the system to earth via protective conductors. Provide earth loop impedance path by earthing and bonding to achieve operation of the earth fault relays as specified. Ensure extraneous conductive parts of the system are in direct contact with all simultaneous accessible parts, if necessary by bonding or connection to the common steelwork structure.

Earth the HV system to one point only. Use the generator or supply transformer star point as indicated.

### **4.13. EARTHING OF LARGE MOBILE OR TRANSPORTABLE PLANT:W5120**

Earth the source via a liquid resistor to limit the rise in potential of the plant to 50V under earth fault conditions. Use screen and armour of trailing and fixed cables as earth path from plant to source. Ensure all cabling and switchgear is suitable for impedance - earthed systems.

### **4.14. EARTHING OF CONSTRUCTION SITE ELECTRICAL SYSTEMS:**

Earth construction site electrical systems to BS 7430, BS 4363 and BS 7375.

### **4.15. EARTHING OF ELECTRICALLY SUPPLIED STREET FURNITURE:**

Install earthing to street furniture in accordance with BS 7430 and BS 7671

For TN-S or TN-C-S systems use cable with separate phase neutral and protective conductors to supply street furniture. Ensure on the load side of the protective device separate phase, neutral and protective conductors are used. Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the supply protective conductor to the same earthing terminal.

For TN-C where the supplier's earth terminal is not used or TT systems install a protective earth electrode system at the source of supply. Use cable with separate phase neutral and protective conductors to supply the street furniture, with the protective conductor connected to the earth electrode. Ensure on the load side of the protective device separate phase, neutral and protective are used. Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the supply protective conductor to the same earthing terminal.

### **4.16. EARTHING OF ELECTRICAL SYSTEMS IN HAZARDOUS AREAS:**

Install earthing of electrical systems in hazardous areas to BS 7430 and BS EN 60079. Use the recommendations in HS(G)41 at petrol filling stations.

### **4.17. OVERHEAD LINE EARTHING:**

Earth overhead line plant in accordance with BS 7430 and the Electrical Safety, Quality and Continuity Regulations. Do not earth or bond insulator steelwork unless so directed.

# Y71 – LV Switchgear & Distribution Boards

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## 1. GENERAL

## 2. STANDARD:

Comply with BS EN 60439-1.

Assemblies shall be type tested (TTA) in accordance with BS EN 60439-1

### 2.1. TYPE TEST:

Provide verification of type test in accordance with Table VII of BS EN 60439-1. For type tested assemblies, the short circuit strength of main busbars, busbar supports, connections to incoming and outgoing units in the configuration to be used, shall be verified. Certificates issued by The Association of Short-Circuit Testing Authorities (Inc) - ASTA - are preferred, but certificates from other testing authorities will be considered.

### 2.2. ELECTRICAL CHARACTERISTICS:

Ensure that electrical characteristics of component parts of assemblies are as indicated and apply when components are mounted in enclosures. Allow appropriate de-rating factors for effect of enclosures, other components and interconnections. Ensure that all components supplied and installed are suitable for Voltage, Current, Fault Levels and Frequency as scheduled.

### 2.3. INFORMATION ON DRAWINGS

The following electrical characteristics are shown on the system or the distribution diagram drawings:-

Type of earthing system

Number and type of live conductors at the origin

Normal Voltage

Frequency

Maximum prospective short-circuit current at the origin (Ip(max)).

Minimum prospective short-circuit current at the origin (Ip(min)).

Earth-fault loop impedance at the origin (Ze)

Electricity supplier's protective device and its tripping time at current Ip

Protective devices

Current rating

Type

Category of duty

## 3. PRODUCTS/MATERIALS

### 3.1. LV SWITCHGEAR AND CONTROLGEAR ASSEMBLY:

Standard - BS EN 60439-1.

External design- Cubicle or Multi-cubicle type assembly as indicated on Schedules or drawings.

Degree of protection BS EN 60529

Indoors boards to be rated to IP31 unless otherwise indicated.

External boards to be rated to IP65

Service conditions - Ambient air temperature and altitude as BS EN 60439.

EMC-Environment A Light Industrial/Commercial

Provide facilities to allow future extension of switchboard at either end.

### 3.2. NEUTRAL POLES

Neutral poles on 4 pole circuit breakers or switches shall be rated at 100% of the current rating indicated for the phase poles. Neutral poles of protection relays on 4 pole circuit breakers shall the same rating as the phase poles, unless indicated otherwise. Neutral links of TP&N circuit

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breakers or switches shall be rated at 100% of the current rating indicated, except when 'double neutral' (DN) links are indicated, where 200% rated links shall be provided.

### 3.3. ASSEMBLY CONSTRUCTION:

Standard BS EN 62208

Material of enclosure to be steel. Supply doors with fastenings and provision for locking in closed position. Use covers which require special tools for removal. Large removable covers to be provided with lifting handles and location brackets. Provide enclosure with fixing holes. Where enclosure is mounted externally provide fixing lugs external to enclosure.

All busbars are to be fully rated for Current carrying capacity, Frequency, Fault Level and rated Voltage as detailed on the drawings and/or schedules. Neutral bars are to be fully rated and not ½ sized bars.

Internal Separation to BS EN 60439-1 National Appendix and as Schedules or Drawings

Assembly to provide protection against direct and indirect contact. Protection to be maintained after removal or withdrawal of removable or withdrawable parts.

Ensure that fixed panel or cubicle of withdrawable type units are fitted with label to identify circuit with wording identical to that on the withdrawable portion.

Terminals for external conductors

Accommodate cross-sectional area of cables scheduled .

Parallel cabling to be provided with an individual terminal for each cable.

Mark terminals as BS 7671.

Provide earth terminal, or for multi-cubicle enclosures a copper earth bar the full length of the enclosure, so that exposed conductive parts of the assembly can be connected to the protective conductor. Ensure earth connection can be made to the assembly without damage to the finish coating. Make provision for armouring and metal sheaths of all incoming and outgoing cables, including common and individual glanding plates, to be bonded to earthing terminal or bar.

Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage.

Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings.

Adjusting and re-setting of relays, releases and electronic devices.

Replacement of fuselinks.

Replacement of indicating lamps.

Fault location by voltage and current measuring.

Accessibility for maintenance.

Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.

Short-circuit protection and short-circuit withstand strength as Schedules or drawings. Co-ordinate short-circuit protective devices and short-circuit current arising from rotating machines as detailed in Work Section V20. For motor control centres this information as detailed in Work Section W61.

Input voltage variations for electronic equipment supply as BS EN 60439,

Supply frequency deviation as BS EN 60439



### 3.4. ENCLOSURES FINISH:

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated in the schedules. When other than manufacturer's standard finish is specified samples for each paint system and for each colour shall be provided.

### 3.5. TYPE TESTS:

Provide certificates of verification of  
temperature rise limits.  
dielectric properties.  
short-circuit strength.  
continuity of protective circuit.  
clearances and creepage distances.  
mechanical operation.  
degree of protection.

Temperature rise limits

Temperature rise test for test current greater than 3150 A to be agreed by the engineers.

Temperature rise when ambient temperature exceeds +40°C or is lower than +10°C to be agreed by the engineers.

Short circuit withstand strength

Value of neutral bar current for short-circuit test 60%.

### 3.6. ROUTINE TESTS

Carry out the following Routine Tests at the works after the panels have been finished and before shipping to site:

Dielectric test

Insulation resistance test

Primary and/or secondary current injection

Phase rotation

Operation of protection devices, instruments and measuring devices

Operation of control and monitoring devices

The Engineers/design team/client shall be invited to witness these tests at a time convenient to them.

### 3.7. TESTS ON SITE

Repeat routine tests on site.

### 3.8. SITE BUILT ASSEMBLIES:

Ensure that components of site assemblies are part of a proprietary system and type tested as defined above. Install assemblies in accordance with manufacturer's drawings and instructions.

### 3.9. SITE MODIFICATION:

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for the arrangement of components.

### 3.10. BATTERY CHARGER AND BATTERY UNIT:

Function, Input Voltage and Frequency as Schedules or drawings.

DC Output Voltage drop at full load 2%

Operating temperature range -10°C to +45°C.

Charger type Thyristor or Transistor.

Battery type Nickel Cadmium (maintenance free).

Enclosure, sheet steel, IP31

Corrosion resistant epoxy paint or Manufacturer's standard.

Colour Manufacturer's standard.

#### Facilities

MCB input protection.

Float charge.

Battery over-discharge protection

Fuses for battery protection.

MCB's for outgoing circuits as indicated.

Automatic selection of boost charge.

#### Meters

Battery voltage.

Charge/discharge current (dual scale for float and boost).

#### Lamp indications

Supply on.

Supply fail (monitor input terminals).

Float charge.

Boost charge.

No charge (when supply is on).

Battery voltage low.

Battery voltage high.

Earth fault on output.

Common Alarm (connected to operate a relay with shrouded 230V 3A a.c. or 0.5A d.c. N/O-N/C volt free contacts, closed on any alarm, for remote indication circuit)

Supply failed.

No charge (when supply is on).

Battery voltage low.

Battery voltage high.

Earth fault on output.

### 3.11. AIR-CIRCUIT BREAKERS

Comply with BS EN 60947-2. Provide fixed or isolating (withdrawable) removable type circuit breakers with provision for safe maintenance. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage and that Utilisation Category is B.

Withdrawable and plug-in circuit breakers shall be provided with an earthing device to permit earthing of either the busbar (main incoming devices only) or outgoing circuit, A minimum of 1 No earthing device shall be provided for each frame size per switchboard.

Provide circuit-breaker with rated service short-circuit breaking capacity (Ics) and short-time withstand current (Icw) equal to or greater than that for the associated switchboard.

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Provide operating mechanism, controls, accessories and protection as indicated on Schedules or drawings.

Provide a minimum of 3 (unless otherwise detailed or required) N/O-N/C volt free auxiliary contacts rated a minimum 10A 230V wired to external terminals within the outgoing cabling section.

Provide interlocks to prevent movement of the circuit-breaker within the housing when in 'closed' or 'service' position. Provide automatic shutters to cover all live contacts when circuit-breaker is isolated, withdrawn or removed from housing.

Provide facility to padlock circuit-breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when breaker withdrawn from housing.

### **3.12. CIRCUIT-BREAKERS-MOULDED CASE**

Comply with BS EN 60947-2. Provide moulded case isolating (withdrawable) or fixed type circuit-breakers, as detailed, with provision for safe maintenance. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage and that Utilisation Category is B.

Withdrawable and plug-in circuit breakers shall be provided with an earthing device to permit earthing of either the busbar (main incoming devices only) or outgoing circuit, A minimum of 1 No earthing device shall be provided for each frame size per switchboard.

Provide circuit-breaker with rated service short-circuit breaking capacity (Ics) and short-time withstand current (Icw) equal to or greater than that for the associated switchboard.

Provide manual closing mechanism and protection by combination of adjustable magnetic/thermal compensating devices unless otherwise indicated.

Provide 2 (unless otherwise indicated or required) N/O - N/C volt free auxiliary contacts rated a minimum of 10A 230V AC wired to external terminals within outgoing cabling section.

Where withdrawable provide interlocks to prevent movement of circuit breaker within housing when in 'closed' or 'service' position. Provide automatic shutters to cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing.

Provide facility to padlock circuit- breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing.

### **3.13. AIR BREAK SWITCHES:**

Comply with BS EN 60947-3. Supply air break switches with uninterrupted rated duty and Utilisation Category AC 23 B.(infrequent operation) unless otherwise indicated.

Operational performance not less than requirements of BS EN 60947-3, Table IV.

Fit fuse switches with cartridge fuse links in accordance with BS 88 (BS EN 60269). Fit removable neutral link in switches controlling circuits with neutral conductor. Fit solid links in isolating switches. Fit each switch with facility to padlock in OFF position.

Ensure that withdrawable chassis isolating type switches are provided with fully shrouded fixed contacts or insulated cover plates, to prevent accidental contact with live parts.

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Ensure that switches have individual enclosures and earth terminal, meet the degree of protection for the switchboard and have operating mechanisms interlinked with access door.

The means of operating (handle, push button etc) switches provided as the means of emergency switching shall be coloured red and the device facia shall be coloured yellow.

### 3.14. PROTECTION DEVICES AND RELAYS

Comply with BS EN 61810.

Provide protection devices and relays as specified in the Work Sections, on drawings or Schedules.

Locate such that operation may be observed and the devices reset or adjusted without access to the interior of the enclosure..

### 3.15. AUTOMATIC TRANSFER SWITCH EQUIPMENT (ATSE)

#### ATSE - Electromechanical ATS'S

Unless indicated otherwise in the Schedules, Electromechanical ATS's shall be enclosed within separate enclosures to their associated lv switchboards.

Where the transfer switch is specified with a draw-out function, shutters shall be provided which automatically close to fully shroud the live terminals when the transfer switch is withdrawn.

For closed transition switches, a timer shall be provided to limit the maximum period that the two sources are connected in parallel (adjustable 0 to 60secs), on expiry of the timer, the source 2 transfer switching device shall open.

Manual bypass facilities provided for test and maintenance purposes shall be incorporated within the ATS enclosure. The bypass shall allow the load to be connected to either of the sources without interruption of the supply to the load and shall be interlocked to prevent paralleling of the two sources.

Volt free contacts shall be located in a segregated section of the ATS enclosure.

#### ATSE - Interlocked Circuit Breakers

Shall comprise of motorised, 'plug-in' pattern non-automatic circuit breakers (Reference Y71.2091 & Y71.2092) mechanically and electrically interlocked to prevent both circuit breakers being simultaneously closed.

The incoming supply section for each device shall be segregated from the other and it shall be possible to remove either circuit breaker for maintenance purposes without disruption of the supply to the load. No live parts shall be exposed by removal of a device and a minimum of IP31 degree of protection shall be maintained.

It shall be possible to perform the following on the circuit breakers from the front facia of the switchboard without opening or removing covers:

Manual opening or closing of each circuit breaker

Padlocking the circuit breaker in their OFF positions for maintenance.

Circuit breakers shall incorporate an opening coil so that they may be opened upon failure of either source.

Mains sensing equipment shall be located within a separate controls section of the lv switchboard / ATSE Assembly.

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Mains sensing shall be carried out by phase failure relays fitted to each supply phase which shall operate upon the voltage between any phase and neutral falling below a pre-set threshold for a pre-set period. After the pre-set period has elapsed and a voltage is sensed on the standby circuit breaker, the primary circuit breaker shall open and the secondary circuit breaker shall close.

Restoration of the normal supply shall be detected by the voltage between all 3 phases and neutral being above the pre-set threshold for a pre-set period.

After the pre-set period has elapsed the primary circuit breaker shall open, the secondary circuit breaker shall close.

Volt free contacts shall be fitted wired to a 'field wiring' terminal rail located within the controls section of the enclosure.

### **3.16. TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES:**

Standard BS EN 60947-5-1

Provide a panel mounted heavy duty, spring return key operated trip/close switch on each circuit-breaker fitted with electrically operated closing mechanism.

Ensure contacts have a continuous rating of 10A minimum at between 30V to 250V ac and dc, and make and break duty rating of 30A at 250V ac or dc for a minimum period of 3 secs.

Where remote trip/close control is required, supply a panel mounted selector switch to select circuit-breaker for local or remote operation. Ensure that selection of remote or local closing does not prevent circuit breaker tripping under fault conditions.

### **3.17. CONTROL CIRCUITS:**

Control circuit voltage shall preferably not exceed 110 Volts ac (55-0-55)

Where control circuits are taken outside the enclosure to remote equipment use 24 Volts ac.

For circuit-breaker shunt trip and protective circuits use 30 Volt dc, for integral protective devices 230 Volts ac, or as otherwise indicated.

Provide control circuit transformers to supply power at voltages to suit control components in accordance with BS 3535, Section D complete with primary and secondary fuses.

### **3.18. CURRENT TRANSFORMERS:**

Comply with BS EN 60044-1. Provide separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with protective device characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.

Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

### **3.19. INSTRUMENTS AND METERS:**

Standards

Comply with BS 89 and BS EN 60051 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.

Comply with BS 7856, BS EN 62053-11, BS EN 62053-22, or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters and BS EN 62053-

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23 for kVArh meters. Where a meter is to be used to measure the amount of electricity supplied for billing purposes, for applications up to 100kW/100kWh the meter shall be MID Approved. For applications above 100kW/100kWh meters shall be of an approved type for electricity, by OFGEM. In addition, meters for domestic use shall be certified.

Protect wiring to voltmeters by separate fuses. Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.

Supply instruments and meters suitable for flush mounting and type, size and accuracy as drawings or schedules.

Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full scale deflection.

Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

### 3.20. INDICATOR LIGHTS:

Standard BS EN 842 and BS EN 60947-5-1

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility. Supply interchangeable indicators for respective units.

Include an integral double wound transformer for each lamp unit on ac indicator circuits. Include an integral ballast resistor for each lamp unit on dc indicator circuits. For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	Filament Lamp. Include an integral double wound transformer for each lamp unit on ac indicator circuits unless otherwise indicated.
Motor control centres	Filament Lamp. Include an integral double wound transformer for each lamp unit on ac indicator circuits , or provide 24V indicator circuits with 30V lamps unless otherwise indicated.
Where appropriate	Neon indicators
Where appropriate	LED

Protect wiring to indicator lamp units by separate cartridge fuses.

Lens Colour in accordance with BS EN 60073.

### 3.21. AUDIBLE ALARMS:

Provide audible alarm system as specified in the Work Section.

### 3.22. PADLOCKS

Provide padlocks and cabinet as specified in Work Section.

Provide each padlock with two keys complete with disc and ring. Engrave disc and padlock with suitable legend.

Provide wall mounted steel cabinet with hinged door for storing padlocks and keys on hooks.

### 3.23. SWITCHBOARD INSTRUMENT AND CONTROL WIRING:

All instrument and control wiring to be either single core insulated cable contained within plastic panel wireway or double insulated cabling installed in a harness.

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Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.

All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS 88 (BS EN 60269).

### **3.24. MOTOR CONTROL CENTRE, STARTER AND CONTROL PANEL INTERNAL WIRING:**

Segregate control wiring from power circuits.

Contain control wiring within plastic wireways or in a harness.

Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.

Take account of thermal effects of grouping when routing power wiring.

All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS 88 (BS EN 60269).

### **3.25. LOW VOLTAGE COILS RATING:**

Ensure coils for switching relays, contactors and other applications are capable of withstanding inherent voltage drop within system without armature or switching apparatus dropping out of position.

### **3.26. FRAMEWORK:**

Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210 and BS 4345 respectively. Comply with BS EN 1011-2 for metal arc welding.

Finish

Frameworks mounted inside building shall have a galvanized finish in accordance with BS EN 10142 or BS EN 10143 and BS EN 10147.

Frameworks mounted outside building shall be hot dip galvanized to BS EN ISO 1461 following fabrication.

Supply cadmium or zinc electroplated bolts, nuts, washers and screws.

### **3.27. FUSES:**

Supply cartridge fuse links including fuse carrier, bases and associated components that comply with BS 88 (BS EN 60269), fusing factor category gG, unless otherwise indicated.

Use motor circuit fuses where indicated.

### **3.28. DISTRIBUTION BOARDS:**

Comply with BS EN 60439-1 and BS EN 60439-3, as appropriate. Enclosure to be steel, with hinged lockable cover, internal separation Form 1, degree of protection IP31, unless otherwise indicated. Make fuseboards fully shrouded. Fit each distribution board with an isolating switch, size as shown on the drawings.

Install busbars in same position relative to their fuse carriers or miniature circuit-breakers (MCBs) for each pole. In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit.

Neutral to be rated as phase conductor.

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Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit. Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure.

Identify each fuseway and MCB way by numbering. Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way.

Provide durable, printed circuit identification chart inside enclosure.

Enclosures finish

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated.

When other than manufacturers standard finish is specified, samples for each type of paint system and for each colour shall be provided.

Provide spare ways, 25% or as indicated. Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank complete with blanking covers for future additions.

### **3.29. CONSUMER UNITS:**

Comply with BS 5486 Part 13 and BS EN 60439-3. Supply consumer units with minimum degree of protection in accordance with BS EN 60947-1, IP31. Provide fuses or miniature circuit-breakers and means of isolation as indicated.

Enclosures finish

For steel enclosure apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise indicated..

When other than manufacturer's standard finish is specified samples for each type of paint system and for each colour shall be provided.

### **3.30. MINIATURE CIRCUIT-BREAKERS:**

Standard BS EN 60898.

Supply miniature circuit-breakers in accordance with BS EN 60898. Voltage and current ratings, type according to instantaneous tripping current, rated braking capacity and frequency as drawings or schedules.

### **3.31. RESIDUAL CURRENT DEVICE:**

Comply with BS EN 61008. Supply residual current devices (RCDs) with rated voltage, rated current, rated tripping current, rated tripping time and rated breaking capacity as indicated.

Rated Tripping Current

30mA unless otherwise indicated on the drawings.

Rated Tripping Time

30ms unless otherwise indicated on the drawings.

Fit RCDs with integral over current protection as detailed on drawings or schedules.

Refrigerators and deep freezers should not be connected to RCD Protected Circuits



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unless written confirmation is obtained.

Supply combined residual current/over current operated circuit-breakers to BS EN 61009

### **3.32. RESIDUAL CURRENT MONITORS**

Standard BS EN 62020

### **3.33. CABLE TERMINATIONS:**

Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.

Provide non-ferrous metal glanding plates for single core cable terminations.

### **3.34. TERMINAL BLOCKS FOR AUXILIARY WIRING:**

Provide rail mounted moulded terminal blocks with fully shrouded connectors, segregation plates, and end clamps. Ensure insulating material is suitable for maximum operating temperature of conductors.

Provide connectors to clamp conductors between metal surfaces. Ensure clamping screws do not make direct contact with conductors. Ensure conductors maintain sufficient contact pressure to ensure negligible impedance. Make metal in contact with conductors 85% copper alloy and screws of metal electrolytically compatible with copper alloy.

Provide each terminal with marking tag fitted into moulded tag slots.

Provide test probe facilities and integral disconnecting device to facilitate testing on terminals for indication, instrumentation and metering.

Manufacture rails from steel, hot dipped galvanised after manufacture.

### **3.35. COMPONENT MOUNTING:**

Mount all components on removable back plates. Ensure no fixings protrude into busbar chamber.

### **3.36. SWITCHGEAR AND CONTROL GEAR ACCESSORIES**

Provide switchgear and controlgear accessories as indicated. Provide insulating mats to BS 921 the operating length of each switchboard of minimum width 1,000mm. Provide all switchgear operating tools required for each switchboard. Provide 10% of the number of each size of fuses used as spare.

## **4. WORKMANSHIP**

### **4.1. FIXING:**

Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts, washers and screws.

### **4.2. MOUNTING HEIGHT:**

Mount single items of equipment 1450mm above finished floor level to centre of equipment, unless otherwise indicated.

Arrange groups of equipment, other than floor mounted assemblies, so that all parts of equipment requiring access for operation or maintenance are at least 500mm and no more than 2000mm above finished floor level (max height of operating handles 1800mm), unless otherwise indicated.

### **4.3. ACCESS:**

Ensure that clearance in front of switchgear and controlgear is not less than 1m, or as indicated.

### **4.4. ACCESS TO CONTROL COMPONENTS:**

Arrange control components to ensure adequate access for operation and maintenance.

### **4.5. ANCILLARIES:**

Install ancillaries in accordance with manufacturer's instructions.

### **4.6. MARKING:**

Number terminals, cables and component parts to correspond with manufacturer's certified drawings.

### **4.7. CABLE TERMINATIONS:**

Terminate paper-insulated cable by means of switchboard manufacturer's standard compound filled cable boxes.

Terminate PVC, XLPE and MICC cables inside enclosure by securing cables to switchboard with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes.

Provide cable support systems within the switchboards between cable entry point and connection to respective devices. Where multicore cables are glanded at a distance from device connection points the inner cable sheath should be maintained and supported and fixed within the switchboard.

### **4.8. INSTALLATION AND COMMISSIONING:**

Install and commission switchgear and controlgear in accordance with the appropriate standard and the manufacturers recommendations. Include CT Polarity check in commissioning tests.

Commissioning of all equipment to be carried out by relevantly qualified specialist personnel.

# Y81 – Testing & Commissioning for Electrical Services

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## 1. GENERAL

## 2. INSPECTION AND TEST PROCEDURE:

Comply with BS 7671 Requirements for Electrical Installations (the IEE Wiring Regulations), IEE Guidance Notes Number 3 Inspection & Testing and other British Standards as indicated.

### 2.1 SUPPLY CHARACTERISTICS:

Obtain information called for in BS 7671 about supply characteristics from Supplier, other than where to be measured as part of testing procedure.

### 2.2 DESIGN INFORMATION:

Obtain all design assumptions, calculations and any other information to enable compliance with BS 7671 to be verified.

### 2.3 INCORPORATED EQUIPMENT CHARACTERISTICS:

Obtain and use information from manufacturers of equipment provided.

Use information provided, for equipment supplied by others and incorporated into installation.

### 2.4 PROSPECTIVE SHORT CIRCUIT CURRENT (IP):

Determine values of IP by measurement, unless other means are indicated. Determine IP at all necessary points within installation to confirm correct equipment selections.

Where necessary obtain from supply undertaker values of IP at the origin of the installation taking into consideration any alternative supply arrangement giving rise to the highest IP value.

### 2.5 INITIAL VERIFICATION:

Carry out detailed inspection to verify the requirements of BS 7671 Section 611 in the order given in clause 611.3.

### 2.6 TEST EQUIPMENT AND CONSUMABLES:

Provide test equipment and consumables in accordance with BS EN 61557 to complete tests satisfactorily, and to retest any failed installations following corrective measures.

Test equipment quality assurance requirements to BS EN ISO 10012.

### 2.7 TESTING

Carry out in the same order as published the tests required by BS 7671 Section 612.

### 2.8 CONTINUITY OF PROTECTIVE CONDUCTORS:

Confirm continuity. Use ac or dc source

### 2.9 EARTH FAULT LOOP IMPEDANCE (ZS):

Use 25 A test current. Measure and record source impedance ( $Z_e$ )

Where necessary obtain from supply undertaker value of  $Z_e$  at the origin of the installation taking into consideration any alternative supply arrangement giving rise to the highest  $Z_e$  value.

Measure  $Z_s$  with main equipotential bonding conductors connected. Do not summate values of several parts of each loop.

### 2.10 SETTINGS AND ADJUSTMENTS:

Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times.

Check correct operation of devices.

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Confirm interlocks and sequences operate safely and as indicated.

## **2.11 STANDBY GENERATORS:**

Perform works tests on standby generators and provide test certificates.

Comply with BS7698, BSEN60034

Carry out load test where specified within Work Sections.

Allow for attendance by the Engineer to witness works tests.

Carry out special tests where indicated in the Works Sections.

## **2.12 HV AND LV SWITCHGEAR:**

Perform works tests on HV and LV switchgear in accordance with BS EN 62271 and BS EN 60439-1, as appropriate, and provide test certificates.

Allow for attendance by the Engineer to witness works tests.

Carry out special tests where indicated in the Works Sections.

## **2.13 HV POWER TRANSFORMERS:**

Perform works tests on HV power transformers in accordance with BS EN 60076, BS 171, Parts 3 and 5 and provide test certificates.

Allow for attendance by the Engineer to witness works tests.

Carry out special tests where indicated in the Works Sections

## **2.14 SPECIALIST INSTALLATIONS:**

Carry out site testing and inspection and provide test certificates for specialist installations in accordance with:-

- fire detection and alarm systems - BS 5839.

- lightning protection - BS 6651.

- fire protection of electronic data processing installations - BS 6266.

- fire extinguishing installations and equipment on premises - BS 5306.

- Emergency Lighting installations and equipment on premises - BS 5266 and BS EN 13032-1.

Fire Alarm and Voice Alarm Installations

The voice alarm system shall be tested in accordance with BS 5839 : Part 8. In particular the following shall be performed;

- All communications and speaker circuit wiring shall be tested for insulation resistance, continuity, presence of earth loops and polarity prior to commencing commissioning.
- Load on each output circuit (subsequent to completion of audibility measurements and final setting of loud speaker tapings).

The Fire Alarm Trade Contractor shall carry out audibility measurements in all areas of the building to ensure that minimum audibility levels have been achieved in accordance with BS 5839 for fire alarm installations and BS EN 60849 Annex C and BS 5839 : Part 8, Clause 28.5. for Voice Alarm Installations.

Audibility measurements shall be performed once areas are complete (including all finishes and furnishings where provided within the Contract) and plant operational under normal conditions. The Fire Alarm Trade Contractor shall allow to adjust loudspeaker tap settings to achieve a sound level within the 'preferred' range. Following adjustments to loudspeaker tapings, audibility measurements shall be repeated.

Results of final audibility measurements and 'as-installed' loudspeaker tap settings shall be recorded on Record Drawings.

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For Voice Alarm Systems, subjective assessment of intelligibility may be acceptable during commissioning and for system demonstration prior to acceptance, if this is the preferred method of the Building Control / Fire Officer. In the event of a dispute, measurements shall be taken in accordance with BS EN 60268-16, any costs associated with these measurements shall be borne by the Electrical Trade Contractor.

Standby power supplies shall be subjected to a discharge test to demonstrate that they have sufficient capacity to maintain power to the system in its quiescent and alarm states, for the rated durations. Dummy loads shall be added to the system to simulate loads allowed for future capacity.

### **2.15 CALIBRATION:**

Provide current certificates of calibration for all instruments used during test procedures. Record particular instrument identity on record sheets.

### **2.16 CERTIFICATION AND REPORTING**

Complete and hand over to the Client a Completion or Periodic Inspection Certificate to BS 7671 Appendix 6 as appropriate.

Certificates shall be accompanied by a complete schedule of test results:

Record details of departures from BS 7671 (IEE Wiring Regulations) on Completion Certificate.

Where appropriate provide copies of calculations justifying departure from BS 7671 (IEE Wiring Regulations) and attach to certificates.

### **2.17 RECORDS:**

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test, as soon as possible after such inspection and test.

## **3. WORKMANSHIP**

### **3.1 CONDUCTIVE PARTS:**

Test for protection against direct and indirect contact in accordance with BS 7671 (IEE Wiring Regulations) dependant on the method of protection.

### **3.2 PHASE SEQUENCE:**

Check and confirm correct polarity of all conductors in all circuits.

### **3.3 HIGH VOLTAGE TESTS:**

Carry out high voltage tests as indicated:

Comply with BS 923, BS EN 61180, BS EN 60060 and BS EN 61180 as appropriate.

### **3.4 CABLES:**

Test continuity and insulation of all cables and carry out HV tests on HV cables prior to handover.

Test continuity and insulation of buried cables immediately after back-filling.

### **3.5 CONDUIT, TRUNKING AND DUCTING:**

Test and confirm electrical continuity of metal containment systems before installing cables.

### 1. PERFORMANCE OBJECTIVES

To provide a piped water supply system to bring water from the supply authority's main and distribute it to a variety of users points.

To provide water storage and a piped water supply system distributing cold water services to a variety of user points using gravity and/or pressure boosters as indicated on the drawings and schedules.

Where a borehole is required, engage a borehole and well specialist to develop design, supply, install including all civil works, commission and set to work the borehole/well.

### 2. DESIGN PARAMETERS

In accordance with BS EN 806 for drinking water systems and BS 6700 (where still applicable), CIBSE Public Health Engineering Guide G, CIBSE TM13, HSE Approved Code of Practice & Guidance L8 (The Control of Legionella Bacteria in Water Systems), the requirements of the Water Supply (Water Fittings) Regulations 1999

Comply with WRAS guidance on prevention of contamination and waste of drinking water supplies (Aug 02)

On healthcare projects comply with the requirements of HTM 04-01.

### 3. PRODUCTS/MATERIALS

Refer to scope of works and schedules in addition to the clauses below.

### 4. PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

### 5. APPROVALS:

Ensure all water fittings and materials are listed in the Water Fittings and Materials Directory published by WRAS.

### Water regulations – Notification of works and Inspections:

The contractor shall notify the local water authority of any notifiable water services installation in accordance with regulation 5 and 6, and arrange for a water authority inspection and approval of installation before handover of the building in accordance with Water Supply (water fittings) Regulations 1999.

### 6. WATER METERS

Install a water meter to the incoming mains supply and / or sub meters within the building as scheduled or described in the scope of works. Install in line strainer upstream of each water meter. Locate the meters to allow for easy access for meter reading by the building's occupants.

Meters and the installation to comply with The Measuring Instruments (Cold-water Meters) Regulations 2006 and - BS EN 14154-1 / 2

Provide full flow accumulative type water meter with dial indicator to record quantity of water passed. Enclose mechanism of each meter within a cast iron body with a helical vane mounted centrally in the body of the meter. Supply an interchangeable pattern mechanism. Incorporate, as an integral part of each meter, a water guide at inlet to direct water evenly on to helical vane. Provide each meter with zeroing device.

Provide isolating valves on either side of each meter assembly (bypasses on potable water systems should be avoided due to the risk of water stagnation/legionella).

Provide flanged connections to BS EN 1092-1, BS EN 1092-2 or BS EN 1092-4 on each meter. Where meters are of smaller bore than connecting pipework, install flanged reducers.  
Provide facility for remote monitoring of peak flow and total water consumption by BMS.

### 7. PRESSURE BOOSTER SETS

The units are to be WRC approved.

Supply a fully automatic, works tested packaged unit on common base plate. The expansion vessel to be to BS EN 13831 and BS 7074, being a sealed pressure vessel filled with nitrogen, and sized to limit the pump starts to a maximum of 10 starts per hour. Booster set to be complete with duplicate pump, pre-wired control panel and interconnecting pipework

Duty and general components to be as scheduled

### 8. BOOSTER SET CONTROL PANEL

Enclosure                      Fabricate from mild steel sheet 1.6mm thickness minimum,

Finish                          Manufacturer's standard

Components as scheduled

Refer to clause W60 320.100 for control panel design and construction.

### 9. SAFETY SHOWERS

Safety Drench - Plumbed-in type, to BS EN 15154-1.

Eye wash. - Plumbed-in type, to BS EN 15154-2.

### 10. INSTANTANEOUS WATER HEATER

Supply and install electric instantaneous water heater(s) to BS EN 60335-2-35 (see S11)

### 11. INSTANTANEOUS SHOWER HEATER

Supply and install electric instantaneous shower heater(s) to BS 6340 (see S11)

### 12. WORKMANSHIP

Comply with the requirements of BS 8000-15 where applicable.

#### 12.1 CONNECTIONS TO TAPS AND APPLIANCES

Make final connections to taps and appliances including the incorporation of a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar.

#### 12.2 INSTALLATION OF WATER COOLERS

Install water coolers in accordance with manufacturer's instructions

#### 12.3 INSTALLATION OF PRESSURE BOOSTER SETS

Install pressure booster sets in accordance with manufacturer's recommendations

#### 12.4 INSTALLATION OF UV DISINFECTION SYSTEMS

Install UV disinfection equipment in accordance with manufacturer's recommendations

Refer to schedule S10sch6 for duty / specific requirements

#### 12.5 ISOLATION

Install isolation valves at the following locations as a minimum standard.

At all terminal units

At all sanitary fittings.

At all main branch connections and at high level in feeds which drop to low level to water outlets in benches etc.

Where piped services feed a zone or floor from risers

All quick fill points and bib taps shall comply with the Water Supply (Water Fittings) Regulations 1999 including where connected into a sub circuit of an existing building.

### **12.6 PIPE LAYING:**

Use slings that do not damage either pipe or coating. Thoroughly inspect pipes prior to slinging. Do not lower pipes until the trench bottom has been approved to receive the pipes. Ensure pipes are in correct alignment and orientation, concentric with the pipes already laid. Make joints in accordance with manufacturer's instructions using the proprietary materials indicated. Use a purpose made adapter for joints between pipes of different materials. If none is available, abut the pipes, tape and seal the gap, surround by 1/2 sections or less for 1m either side of the joint and surround in C20 concrete 150mm thick for 2m either side of the joint. Install PVC-U pipes and fittings in accordance with BS 5955-6.

### **12.7 STRUCTURES:**

Ensure pipes in and out of structures are as short as possible. Surround by concrete at least 150mm thick. Set pipes sufficiently steep to prevent the possibility of differential settlement causing a backfall.

### **12.8 BEDDING, PROTECTION AND BACKFILL:**

Make cavities in the bedding to facilitate sling removal. Elsewhere smooth the trench bottom. Prepare one full pipe length in advance of pipelaying. Locate interfaces between backfilled materials to the weaker material side of theoretical. Concrete is the strongest and selected fill the weakest. Lay all fill less than 300mm above the top of the pipe barrel in 150mm layers and hand compact. Above this level layers may be 225mm. Over 1m above top of pipe mechanical compaction may be used.

### **12.9 WARNING MARKER TAPES:**

Lay during backfilling in a continuous line over pipelines, 300 to 400mm below the level of the finished surface. Lay an additional marker 600mm above the top of the pipeline for pipes at a greater depth than

### **12.10 LIFTING KEYS:**

Provide lifting keys for each type of access cover and hand over to the Employer at Practical Completion.

### **12.11 WATER TESTING OF MANHOLES/INSPECTION CHAMBERS:**

Before backfilling test each manhole or chamber in accordance with BS EN 752, paragraph 25.7 for Exfiltration

Ensure drop in water level is less than relevant dimension in Table 9.

Infiltration

Inflow to be not more than 5 litres per hour per manhole.

### **12.12 EXCAVATION**

Excavate in a clean and organised manner. Schedule with other site activities to provide controlled access and minimal tracking of soil over the site.

Set out and use sight boards to ensure uniform falls.

Separate top soil and set aside for later use.

Evacuate trench width to a minimum of 300mm above the top of the pipe barrel within indicated limits. Keep available materials for adequate shoring when excavation depth over 1.2m is intended in accordance with the construction (General Provision) Regulations.

Where rock is encountered in trench bottoms designed as Class D bedding further excavate to the depth necessary to receive Class F.

Backfill over-excavation, whether intentional at soft spots or accidental with rubble. Spoil, which is either in excess of or does not fulfil the requirements for selected fill.

Place in spoil heaps, or Take off site as directed.



### 13. WORKMANSHIP

#### 13.1 PIPELINE ROUTES:

Ensure pipeline routes are as short as possible consistent with, natural topography and subsoil conditions.  
as far as possible increasing slopes downstream.  
avoidance of tree root growth areas.

#### 13.2 MATERIALS IN THE WORKS:

Inspect all buried materials prior to installation. Make good damaged coatings and cut ends.  
Reject where damage is more than superficial.

#### 13.3 QUALITY CONTROL:

Check that all materials comply with the indicated standard before acceptance to store. Transport, handle and store in accordance with manufacturer's recommendations, to avoid damage or contamination.

Obtain all components for each type of pipework from the same manufacturer.

Ensure cut ends of pipes are clean, square and free of burrs.

Prepare trenches to receive pipes and allow for jointing, testing and removal of slings.

Install all components in accordance with the manufacturer's recommendations.

Joint according to manufacturer's recommendations and allow for movement, taking particular care next to buildings and manholes.

Prevent entry of foreign matter and clean prior to testing or putting to use.

Backfill and compact in layers to ensure adequate consolidation.

#### 13.4 SUPPORTS:

Arrange supports for control components to ensure no strain is imposed on components.

#### 13.5 ACCESS:

Arrange control components to ensure adequate access for operation and maintenance

## 1. PERFORMANCE OBJECTIVES

To provide a piped supply system generated, storing and distributing hot water to sanitary fittings, sinks and other appliances. DHW systems shall be designed to deliver water to take-off points at a temperature of not less than 50°C and not exceeding 60°C.

## 2. DESIGN PARAMETERS

In accordance with BS 6700:1997, CIBSE Public Health Guide G, CIBSE TM 13, HSC Approved Code of Practice & Guidance L8 and the requirements of the Water Supply (Water Fittings) Regulations 1999. In addition to controls requirements detailed elsewhere in the specification, provide the minimum controls package for compliance with Part L as defined in the Non Domestic Heating, Cooling and Ventilation compliance guide

On healthcare projects comply with the requirements of HTM 04-01.

Unvented units to be complete with “unvented kits” and pressure regulating valve to comply with Building Regulations safety requirements within Approved Document G3. Units shall comply with BS EN 12897

See Schedule of Common Design Criteria.

## 3. PRODUCTS/MATERIALS

See scope of Works and Schedules

## 4. PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

## 5. APPROVALS:

Ensure all water fittings and materials are listed in the Water Fittings and Materials Directory published by WRAS.

## 6. INSTANTANEOUS WATER HEATER(S):

Supply and install

Gas fired instantaneous water heater to BS EN 26.

Electric instantaneous water heater to BS EN 60335-2-35.

Electric instantaneous shower heater to BS 6340.

7.

## 8. STORAGE WATER HEATER(S):

Supply and install

Gas fired storage water heater to BS EN 89.

Electric storage water heater to BS EN 60335-2-21.

Electric immersion heater to BS EN 60335-2-73.

## 9. THERMOSTATIC MIXING VALVES:

Standard

BS EN 1111

Type 1 - single control.

Type 2 - dual control.

Type 3 - single sequential control.

Type 4 - without flow control device.

Type 5 - with special control devices.

BS EN 1287 for low pressure

Type 1 - single control.

- Type 2 - dual control.
- Type 3 - single sequential control.
- Type 4 - without flow control device.
- Type 5 - with special control devices.

BS 7942 for use in care establishments.

Type a, both flow control and user adjustment of mixed water temperature.

Type b, flow control and pre-set mixed water temperature.

Type c, without flow control and with pre-set temperature

### **10. MECHANICAL MIXING VALVES:**

Standard

BS EN 1286

Single control for adjusting flow rate and temperature.

### **11. EXPANSION VESSELS:**

Standards

Supply expansion vessels for unvented hot water supply systems in accordance with the following standards.

BS 6144.

BS 7074-1.

BS 7074-2.

BS 6920.

### **12. WORKMANSHIP**

Comply with the requirements of BS 8000-15 where applicable.

#### **12.1 CONNECTIONS TO TAPS AND APPLIANCES**

Make final connections to taps and appliances including the incorporation of a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar.

#### **12.2 WATER HEATER INSTALLATIONS**

Comply with manufacturer's instructions and recommendations for the installation of heater.

Locate heater with adequate surrounding space for service and maintenance.

#### **12.3 INSTALLATION OF MIXING VALVES:**

Install thermostatic mixing valves and mechanical mixing valves in accordance with manufacturer's recommendations.

#### **12.4 ISOLATION**

Install isolation valves at the following locations as a minimum standard.

At all terminal units

At all sanitary fittings.

At all main branch connections and at high level in feeds which drop to low level to water outlets in benches etc.

Where piped services feed a zone or floor from risers

## 1. PERFORMANCE OBJECTIVES

To provide a heat source by means of a solar collection system.

## 2. DESIGN PARAMETERS

See Schedule of Common Design Criteria.

## 3. SPECIFICATION CLAUSES SPECIFIC TO T15

### GENERAL

#### 3.1. PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Safety Systems Regulations 2000, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive

#### 3.2. SOLAR COLLECTOR SPECIALISTS:

Engage a specialist to provide a solar collector system, including

- plant design.
- development of design.
- supply.
- installation.
- commissioning.
- setting to work.

#### 3.3. APPROVAL AND SAFETY:

Obtain approval for the installation and operation of the solar collector system from appropriate Local Authorities and comply with all safety requirements and regulations including.

- Planning permission.
- Water Supply (Water Fittings) Regulations 1999 and amendment 1999
- Building regulations.
- Fire regulations.
- Health and Safety at Work Act.

#### 3.4. TESTING:

Standard

Test all solar collector panels at the manufacturer's works in accordance with BS EN 12975-2 or BS EN 12976 -2

For collector panels for swimming pools see BS 6785.

System test

Test pipework to pressure and temperature conditions of the system.

#### 3.5. SOLAR COLLECTOR SYSTEM – PRODUCTS AND MATERIALS

See Scope of Works/Schedules

Comply with DD ENV 12977 where appropriate

#### 3.6. ELECTRICAL WIRING AND SAFETY CONTROLS:

Standards

Provide the solar collector installation with electrical wiring and safety controls in accordance with:

Manufacturer's recommendations and BS EN 12976

For domestic systems comply with BS EN 60730 regarding electrical controls.  
BS 7671 (I.E.E. Wiring Regulations).

### **3.7. SELF-SUPPORTING FRAMEWORK:**

Install a self-supporting framework of corrosion resistant material for the solar collector panel arrangement.

Refer to drawings for details of framework mounting

## **4. WORKMANSHIP**

### **4.1. INSTALLATION:**

Install, commission and set to work the solar collector system in accordance with the manufacturer's instructions.

Generally comply with BS EN 12975

### **4.2. LOCATION:**

Locate the solar collector in accordance with BS 6785 for swimming pools

Generally comply with BS EN 12975

Take account of:

- existing buildings, trees.
- thermal performance.
- orientation.
- shade factor.
- wind exposure.
- access for maintenance.
- pipework connections.
- inspection access.
- vandalism.

### **4.3. QUALITY CONTROL:**

Handle, store and install all equipment and components of the solar collector system in accordance with the manufacturer's recommendations and good practice so as to meet the design and performance requirements. Obtain all solar collector system components from approved sources.

Inspect all components on delivery before fixing and after installation and reject and replace any which are damaged or defective.

Allow for thermal and building movement when fixing and joining components and pipework.

### **4.4. PIPEWORK INSTALLATION:**

Install the solar collector system pipework in accordance with the manufacturer's recommendations.

Comply with BS 6785 for swimming pools

Comply with BS EN 12975

## 1. GENERAL

### 1.1 STANDARDS / REGULATIONS:

Comply with British Standards as indicated and The Water Supply (water fittings) Regulations 1999.

Unvented units to be complete with “unvented kits” and pressure regulating valve to comply with Building Regulations safety requirements within Approved Document G3. Units shall be comply with BS EN 12897.

### 1.2 DEFINITIONS:

Direct cylinder

A closed cylindrical vessel with domed ends.

Indirect cylinder

A closed cylindrical vessel with domed ends having separate integral means of heating contents by annular or coil type element.

Combination unit

An indirect/direct cylinder of double or single feed type with attached feed cistern.

Calorifier

A closed cylindrical vessel having separate integral means of heating contents by 'U' tube chest type element.

Primary heater

A heater mounted inside the cylinder or calorifier for transfer of heat to stored water from primary medium.

Capacity

The volume of water storage excluding contents of any primary heater.

Secondary Working head

The vertical distance between bottom of cylinder or calorifier and water line of cistern supplying cylinder or calorifier.

## 2. PRODUCTS/MATERIALS

### 2.1 HEATING SURFACE

In order to ensure that temperatures are maintained throughout the life of the plant, the primary heating surface shall be sized at 20% greater than the design duty.

### 2.2 COPPER DIRECT CYLINDERS:

Standard BS 1566-1: 2002. type D, vertical arrangement

Connections as BS 1566-1:2002.

Provide screwed boss for drain tap.

Features

Drain cock (minimum size 50mm).

Manhole, 500mm dia min.

Supports

Purpose made feet or support frame.

Provide protective isolation material to prevent electrolytic action where mild steel is used.

### 2.3 COPPER DIRECT CYLINDERS WITH IMMERSION HEATER:

Standard BS 1566-1:2002 type D vertical arrangement.

Connections as BS 1566-1.

Provide connections for combined immersion heater and thermostat; and screwed boss for drain tap.

Features

Combined immersion heater and thermostat

Drain cock (minimum size 50mm).

Manhole, 500mm dia min.

Supports

Purpose made feet or support frame.

Provide protective isolation material to prevent electrolytic action where mild steel is used.

### **2.4 COPPER DOUBLE FEED INDIRECT CYLINDERS:**

Standard - BS 1566 Part 1; type G vertical arrangement.

Primary heater, coil type C.

Connections as BS 1566 Part 1.

Provide screwed boss for drain cock.

Features

Drain cock (50mm min)

Manhole, 500mm dia min.

Supports

Purpose made feet or support frame.

Provide protective isolation material to prevent electrolytic action where mild steel is used.

### **2.5 COPPER DOUBLE FEED INDIRECT CYLINDERS: (PRESSURISED SYSTEM)**

Standard - BS 1566 Part 1; type P vertical arrangement.

Primary heater, coil type C.

Connections as BS 1566 Part 1.

Provide screwed boss for drain cock.

Features

Drain cock (minimum size 50mm)

Expansion vessel, NRV and anti-vac valve

High limit stat directly wired or piped to a non resetting cut off valve on the on the heating return from the vessel

Manhole, 500mm dia min.

Supports

Purpose made feet or support frame.

Provide protective isolation material to prevent electrolytic action where mild steel is used.

To be manufactured as a factory built and tested arrangement to meet the requirements of the Building Regulations.

### **2.6 STAINLESS STEEL INDIRECT CYLINDER:**

Materials

Water container - stainless steel.

Casing - white plastic coated steel.

Thermal insulation

40-50mm thick CFC free fire retardant polyurethane.

Connections

Manufacturer's standard.

Features

Combined immersion heater and thermostat.

Temperature and pressure relief valve with discharge.

Drain cock.

Purpose made feet or support frame.

### **2.7 COPPER CALORIFIER/STORAGE VESSELS TO BS 853:**

Method of heating - Hot water.

Inspection opening

Manhole, 500mm dia min.

Horizontal or vertical as shown on drawings.

Bolted end unless otherwise indicated.

## Y23 – Storage Cylinders & Calorifiers

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Type of heater

Fixed helical coil; withdrawable helical coil; or U-tube battery.

Shell material - copper.

Material test certificates to BS 853 clause 5.3.

Hydraulic test certificates to BS 853 clause 11.2.

Provide connections and supports as necessary. Drain cock to be 50mm minimum.

Mountings to BS 853

Pressure relief devices as clause 10.2; stop valves as clause 10.3; pressure gauge as clause 10.4; thermometer as clause 10.5; draining taps as clause 10.6; and vacuum breaker valve as clause 10.7.

### 3. WORKMANSHIP

#### 3.1 GENERAL:

Store, handle and erect all in accordance with manufacturer's recommendations and relevant British Standards. Make allowance for valves, fittings, access etc., to accommodate insulation/weathering.

#### 3.2 FLANGE DRILLINGS:

Ensure flange drillings are uniform to facilitate interchange of tube assemblies.

#### 3.3 PROTECTION AND CLEANING:

Ensure protection from damage and ingress of foreign matter to cylinders and calorifiers during storage, installation and testing.

#### 3.4 INSPECTION AND CLEANING:

Install cylinders and calorifiers such that internal surfaces and external surfaces can be readily inspected and cleaned.



# Y51 Testing and Commissioning of Mechanical services

## 1. GENERAL

Undertake inspection and commissioning of the building services systems in accordance with The Building Regulations Approved Documents L1 & L2 and relevant CIBSE / BSRIA commissioning codes.

Where an existing system has been extended or modified, then, unless noted otherwise in the scope of works, the complete system shall be re-commissioned. For example if a new prime mover has been installed or the original prime mover up rated in an air or water system and the system has been extended to serve additional terminals.

Appoint a commissioning manager / Specialist Commissioning Agent and undertake Commissioning Management in accordance with CIBSE commissioning code M.

The Contractor shall review all designs to ensure that systems are commissionable in accordance with the codes of practice detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

Produce and issue a notice to the local authority at the end of the commissioning that shall declare that a commissioning plan has been produced and followed and the commissioning results confirm that the performance of the engineering systems is in accordance with the original design. Where deviations / excursions from the design have been agreed with the designers / and client these shall be documented in the notice.

During the commissioning stage systems shall not be left running / unattended without Contractor attendance on site eg overnight or during weekends. Should a component failure occur the engineering services shall be configured to safely shut down.

Carry out Seasonal Commissioning as defined in clause 1002 (in accordance with the requirements of BREEAM) where specified in A31sch1 or A31sch2.

For Dry Riser and Wet Rise fire fighting mains; where identified elsewhere within this specification or required by the local fire brigade, comply with the requirements of BS 9990 Clause 7.2 for protection of buildings under construction

## 2. DEFINITIONS

The following definitions, generally extracted from BSRIA Application Guides 2/89.3 and 3/89.3, and BREEAM Offices 2006 and shall apply to all systems.

### **Capacity Tests**

The proving that the capacity of installed plant and equipment items meets the specified duty.

### **Commissioning**

The advancement of an installation from the stage of static completion to working order to specified requirements.

### **Design Criteria**

The measurements and quantities selected as the basis for the design of a system.

### **Performance Criteria**

The specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

### **Performance Testing**

The proving that the installed system can maintain the specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

# **Y51 Testing and Commissioning of Mechanical services**

## **Fine Tuning**

The adjustment of a system where usage and system proving has shown such a need.

## **Pre-Commissioning Checks**

Specified systematic checking of a completed installation to establish its suitability for commissioning.

## **Pressure and Leakage Testing**

The measurement and recording of pressure retention, and fluid losses or gains in the plant Equipment, distribution ways and terminals.

## **Regulation**

The process of adjusting the rates of fluid flow in a distribution system to achieve specified values.

## **Setting to Work**

The process of setting a static system in motion.

## **Static Completion**

The state of the system, installed in accordance with the specification, clean and ready for setting to work. In the case of wet systems this includes flushing, cleaning, filling and venting.

## **System Proving**

Measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.

## **Testing**

The measurement and recording of specified quantifiable characteristics of an installation or parts thereof.

NOTE: This includes off-site testing.

## **Environmental testing**

The measurement and recording of internal environmental conditions including temperature, humidity and noise levels (with artificial loads applied and using instruments independent of the BMS where indicated).

The measurement of external noise levels

Refer to scope of work and Y51sch2 for details.

## **Seasonal Commissioning (as defined in BREEAM)**

For buildings with Complex Systems including air conditioning, mechanical ventilation, displacement ventilation, complex passive ventilation systems, Building Management Systems and renewable energy sources the Commissioning Specialist shall undertake the following:.

# Y51 Testing and Commissioning of Mechanical services

The testing of all building services under full load conditions, i.e. heating equipment in mid winter, cooling/ventilation equipment in mid summer, and under part load conditions (spring/autumn).

Where applicable, testing should also be carried out during periods of extreme (high or low) occupancy.

Carry out interviews with building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems.

Undertake re-commissioning of systems (following any work needed to serve revised loads), and incorporating any revisions in operating procedures into the O&M manuals

For simple buildings (largely naturally ventilated using cross flow ventilation) the Building Manager or his agent should review the thermal comfort, ventilation, and lighting at 3, 6 and 9 month intervals after initial occupation, either by measurement or occupant feedback.

## 3. STATIC TESTING

### 3.1 PRESSURE - GENERAL:

Comply with procedures given in HVCA Guide to Good Practice for Site Pressure Testing of Pipework. (TR6 2006) Ensure safety precautions detailed in HSE Guidance Note GS4 Safety in Pressure Testing are adopted. Isolate components that cannot withstand the test pressures. Isolate these as near to the component as possible.

Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to section under test.

Test concealed or buried pipework and ductlines before any permanent covering is applied.

Carry out works test for individual items of equipment as detailed in the work sections of this specification

Advise appropriate personnel, in advance, of the time tests may be witnessed.

Agree test pressure and duration for water mains with local water authority.

### 3.2 PRESSURE AND LEAKAGE TESTING - AIR DUCTLINES:

Carry out air pressure and leakage testing on air ductlines in accordance with DW 144 or DW 154as appropriate and as indicated in section Y30.

### 3.3 PRESSURE AND LEAKAGE TESTING - BUILDER'S WORK SHAFTS, VOIDS AND ENCLOSURES:

Ensure all builder's work shafts, voids and enclosures are pressure and leakage tested, and signify acceptance of standard and integrity of construction, prior to pre-commissioning of engineering installations.

### 3.4 PRESSURE TESTING - WATER CIRCULATING AND SUPPLY SYSTEMS AND STEAM AND CONDENSE LINES:

Carry out Hydraulic Pressure Testing as described in HVCA Guide to good Practice for Site Pressure Testing of Pipework (TR6 2006). Test section by section for one hour, as the work proceeds and prior to application of thermal insulation as follows

Operating gauge pressure less than 3.5 bar, test gauge pressure one and a half times operating pressure.

Operating gauge pressure 3.5 - 7.0 bar, test gauge pressure twice operating pressure.

Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times operating pressure whichever is the greater.

### 3.5 PRESSURE TESTING - UNDERGROUND PIPEWORK, 4 HOURS:

Test to a gauge pressure twice the operating pressure or 7 bar, whichever is the greater, for 4 hours.

# **Y51 Testing and Commissioning of Mechanical services**

## **3.6 PRESSURE AND LEAKAGE TESTING - WATER SERVICES INSTALLATIONS:**

Inspect and test water services installations in accordance with BS 6700:1997 and to the requirements of the Local Water Undertaking.

Ensure the provisions laid down in HVCA Guide to Good Practice for Site Pressure Testing of Pipework (TR6 2006) for testing underground CWS mains are carried out.

## **3.7 PRESSURE TESTING - FIRE RISERS:**

Comply with the testing and commissioning requirements set down in BS 9990

For Dry Riser mains undertake static water test to a pressure of 10bar at the highest outlet for a minimum period of 15 minutes.

On completion of the static test check operation of the non return valves integral within the inlet breeching unit by using the static pressure exerted by the full water capacity of the riser.

For Wet Riser pipework undertake static water pressure test to a pressure not less than the system closed valve pressure exerted by the wet riser pump set when designed to operate at the flow and pressure defined in BS 9990 clause 6.4.1.4. Ensure pressure is maintained for a minimum period of 15minutes.

## **3.8 PRESSURE TESTING - REFRIGERANT PIPEWORK:**

Test refrigerant pipework using the strength test procedure as detailed in Clause R6.4 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the leak test procedure as detailed in Clause R6.5 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the deep vacuum test method as detailed in Clause R6.6 of the CIBSE Commissioning Code R: 2002

## **3.9 PRESSURE AND LEAKAGE TESTING - GAS PIPEWORK OTHER THAN MEDICAL GASES:**

Pressure test gas supply pipework systems in accordance with BS EN 12327:2000

For Natural gas systems, Purging and soundness testing shall only be carried out by authorised persons in accordance with the Institutions of Gas Engineers Publication IGE/UP/1 "Soundness Testing and Purging of Industrial and Commercial Gas Installations".

Test records shall be kept based on IGE/UP/1 requirements and prepared to provide a record of satisfactory witnessed tests and procedures for soundness testing and purging.

For other systems (such as gaseous fire protection systems), carry out a pneumatic leak test followed by a pneumatic pressure test as described in HVCA Guide to Good Practice for Site Pressure Testing of Pipework (TR6 2006). Upon their completion, pressure/leak test the areas to be protected to ensure that their leakage characteristics are as assumed in the specialist's design.

## **3.10 PRESSURE TESTING - OIL PIPEWORK TO BS 5410:**

Test oil pipework in accordance with BS 5410-2, Section 39.

## **3.11 PRESSURE AND LEAKAGE TESTING - SOIL, WASTE, VENTILATION, ANTI-SYPHON AND RAINWATER PIPEWORK:**

Test section by section as the work proceeds and subsequently on completion with all sanitary fittings fixed and working.

Submit systems to two separate tests, Air test and Hydraulic Performance test in accordance with BS EN 12056 – 2 – 2000.

Siphonic rainwater pipework shall be tested in accordance with manufacturer's recommendations.

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## **3.12 PRESSURE TESTING - UNDERSLAB DRAINAGE:**

Test section by section as the work proceeds and subsequently after completion of backfilling and compaction to the satisfaction of the Engineers and the local Authority.

Individually test sections which will be permanently embedded in the structure or concealed in ducts or voids.

Submit sections to two separate tests Water test and Test for Straightness and Obstruction in accordance with BS EN 752.

## **3.13 TESTING WIRING INSTALLATIONS:**

Ensure all electrical installations associated with the system, are tested in accordance with the IEE Regulations, 17th Edition (BS 7671), before any plant is run.

## **3.14 TESTING RECORDS:**

Keep a systematic record of tests. Submit samples of test record sheets for agreement prior to testing. Obtain signatures of nominated witnesses to tests. Distribute records as indicated in specification section A33.

# **4. COMMISSIONING**

## **4.1 COMMISSIONING PROPOSALS**

Submit proposals for commissioning as indicated in specification work Section A33 or A64 - General Engineering Technical Items. Use commissioning specialists who are members of The Commissioning Specialist Association (CSA).

## **4.2 CLEANING DUCTWORK SYSTEMS:**

Clean ductwork before plant is first run, using access openings in ductwork. Carry out cleanliness checks and procedures listed in CIBSE Commissioning Code Series A Air Distribution and BSRIA Application Guide 3/89.3 The Commissioning of Air Systems in Buildings. Also refer to specification section Y30, clause 4091.

## **4.3 CLEANING PIPEWORK SYSTEMS:**

Flush and clean all pipework systems before the plant is first run. Carry out flushing procedures listed in CIBSE Commissioning Code W: Water Distribution Systems and BSRIA Application Guide AG 1/2001 Pre-commissioning cleaning of pipework systems. and the requirements of specification section Y25.

## **4.4 COMMISSIONING CODES:**

Carry out commissioning of installations in accordance with the latest version of the relevant BSRIA Application Guides and CIBSE Commissioning Codes.

## **4.5 COMMISSIONING WATER DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:**

Preliminary checks

Carry out checks and procedures as detailed in CIBSE Commissioning Code W.

Ensure system is statically complete as defined in section B4 of BSRIA Application Guide 2/89.3 Commissioning of water systems in buildings

Use pre-commissioning checklist from BSRIA Application guide 2/89.3

Setting to work and regulation

Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W, and sections C3 and C4 in BSRIA Application Guide 2/89.3

Undertake an initial scan of the system and document the results.

Measurement

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Use instruments for measurement generally as detailed in BSRIA Application Guide 2/89.3

For each belt driven pump provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

Carry out commissioning of variable flow water systems in accordance with BSRIA Application Guide AG16/2002 – “Variable flow water systems, Design, installation and commissioning guidance” and CIBSE KS9 “Commissioning variable flow pipework systems”

### **4.6 COMMISSIONING AIR DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:**

#### **Preliminary checks**

Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1. Ensure system is statically complete as defined in section B4 of BSRIA Application Guide 3/89.3 Commissioning of air systems in buildings.

Use pre-commissioning checklist in BSRIA Application guide 3/89.3

#### **Setting to work and regulation**

Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A, Section A2, and sections C3, C4 and C5 in BSRIA Application Guide 3/89. Undertake an initial scan of the system and document the results.

#### **Measurement of air flow**

Use instruments for measurement and methods of measurement detailed in BSRIA Application Guide 3/89.3 and CIBSE commissioning guide, section A3.

For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.

For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.

### **4.7 COMMISSIONING VAV AIR DISTRIBUTION SYSTEMS INCLUDING BSRIA PRE-COMMISSIONING CHECKLIST:**

#### **Preliminary checks**

Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1. Ensure system is statically complete as defined in section B4 of BSRIA Application Guide 3/89.3 Commissioning of air systems in buildings.

Use pre-commissioning checklist in BSRIA Application guide 3/89.3

#### **Setting to work and regulation**

Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A, Section A2, and sections C3, C4 and C5 in BSRIA Application Guide 3/89.3 Undertake an initial scan of the system and document the results.

For regulation of Variable Air Volume Systems follow routine in BSRIA Application Guide 1/91 The commissioning of VAV systems.

Carry out fan volume checks at both maximum and minimum duties to confirm that the air volume differential between supply and extract is maintained at both extremes of duty.

#### **Measurement of air flow**

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Use instruments for measurement and methods of measurement detailed in BSRIA Application Guide 3/89.3 and CIBSE commissioning guide, section A3.

## 4.8 COMMISSIONING BOILER PLANT:

Follow the procedures laid down for carrying out Preliminary Checks and Start Operation in accordance with CIBSE Commissioning Code B and manufacturers instructions.

Apparatus and Instruments

Use Apparatus and Instruments detailed in CIBSE Commissioning Code B, Appendix B3.1. Apply tolerances defined in Appendix B3.2.

Commission the combustion aspects steam boiler plant in accordance with the principles outlined in CIBSE Commissioning Code B. Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boiler plant. The boiler manufacturers in accordance with a method statement, which has been approved by the client's insurance inspectors and the CA, must commission steam boiler plant.

## 4.9 COMMISSIONING STEAM SYSTEMS:

Commission steam systems in accordance with:

CSA (Commissioning Specialists Association) Technical Memorandum - TM 7 Commissioning of Steam Systems.

## 4.10 COMMISSIONING OF GAS PLANT AND SYSTEMS:

Commission gas fired plant on industrial and commercial premises in accordance with IGEN/UP/4.

Comply with the requirements of section 17 of IGEN / UP / 2 for completion, commissioning and handover of gas installations.

Commission gas supply systems in accordance with BS EN 12327.

## 4.11 COMMISSIONING REFRIGERATING SYSTEMS:

Commission refrigerating systems in accordance with CIBSE Commissioning code R:2002

Use the testing and commissioning requirements in ARI 560 :2000 for absorption machines.

## 4.12 BMS COMMISSIONING – PRE-COMMISSIONING (inc NES clause 3140)

Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.

Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.

Ensure that dampers can be manually opened to allow the commissioning of air systems.

Ensure that as much pre-commissioning work as possible is performed off-site:

Ensure that the following is followed:

### *Pre-commissioning action*

### *Pre-commissioning off-site*

Control application software

Yes (final commissioning on-site)

User interface software

Yes (final commissioning on-site)

Control panels

Yes (final commissioning on-site)

Terminal units (fan coil units, etc)

Yes (final commissioning on site)

Wiring

No

Communications network

No

Sensors

No

Actuators

No

Integration gateways

Partial

Ensure that a record of all settings, set-points and offsets are maintained throughout the pre-commissioning period.

Ensure that all final physical adjustments to the field devices are indelibly marked.

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Ensure that all packaged plant interfaced with the BMS is fully tested and commissioned by the manufacturer or installer.

Ensure that the BMS is pre-commissioned in accordance with the requirements of CIBSE Code C (Commissioning of automatic control systems).

Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.

Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.

Ensure that dampers can be manually opened to allow the commissioning of air systems.

### 4.13 BMS COMMISSIONING - PLANT READY FOR CONTROL SYSTEM COMMISSIONING

Confirm that the following plant commissioning has been performed before commencing the final BMS commissioning:

Water systems

The system is cleaned and flushed to remove any debris.

All regulating, isolating and control valves in place and operating correctly.

That all flow measuring devices are in place and in the correct location for accurate measurement (including pressure tapings).

The system is vented.

That the proportional balancing is completed to obtain the branch flow rates in the correct ratio to each other (or through the use of and setting of self-balancing valves).

That the pump flow rate has been adjusted to provide the specified flow rate.

Air systems

Debris has been removed from the air distribution system.

That dampers are in the correct location and fully functional.

That fire/smoke dampers open.

Test holes have been drilled and sealed with removable plugs.

That in-situ flow measuring devices have been installed.

Ductwork air leakage testing has been performed (if specified).

Completion of proportional balancing of regulating dampers so that terminals share the air flow in the correct proportions.

Regulation of the fan(s) to provide the specified flow rate.

Packaged equipment

Ensure that plant and controls have been fully commissioned and are functional, ready for integration with other plant/systems.

That control equipment inputs/outputs are in the specified format for connection to the main control system.

Confirm that the plant is commissioned in accordance with:

Air distribution systems, CIBSE Code A

Boiler plant, CIBSE Code B

Refrigeration systems, CIBSE Code R

Water distribution systems, CIBSE Code W

The commissioning of water systems in buildings, AG 2/89.3, BSRIA

The commissioning of air systems in buildings, AG 3/89.3, BSRIA.

### 4.14 COMMISSIONING BMS / AUTOMATIC CONTROL SYSTEMS

Carry out commissioning of Automatic Control Systems in accordance with Manual prepared by the controls equipment manufacturer. Carry out the Checking and Setting-Up procedure detailed in the CIBSE Commissioning Code C, Section C1.

Measurement

Carry out measurements in accordance with CIBSE Commissioning Code C, Appendix C2.1.

Ensure that the BMS is commissioned in accordance with the requirements of CIBSE Code C. Wherever possible load, prove and commission all software off-site.

Carry out all tests necessary to ensure the correct operational state of the installation. Load and prove all software. Set all variable parameters and switches to the appropriate values and settings to ensure compliance with the specification.

Prior to activating any BMS control of plant demonstrate all safety interlocks and ensure all fail safe conditions are implemented and operational.



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Record values and settings of all variable parameters and switches set as part of the commissioning process. Include these records in Record Documents.  
Indelibly mark all physical adjustments to BMS devices.

## **4.15 BMS WITNESSING REQUIREMENTS: (NES clause A32 151.000 / W60 360.010))**

The Contractor shall implement the following CA's witnessing requirements. Ensure that on-site commissioning staff facilitate the witnessing process.

Confirm that the BMS hardware is installed in accordance with Section W60.

Verify any operator software and associated graphics.

Witness completely the control of any main and/or critical items of plant along with a random sample of other points.

If less than 300 points, witness all points. Between 300 and 1,000 points witness 50% (minimum of 300 to be witnessed). If more than 1,000 points witness 20% (with a minimum of 500 points witnessed).

Reserve the right to witness 100% of the points if the failure rate is greater than 5%.

Witness a sample of specific functions, eg 10% of alarms and 10% of data logging.

Witness one of several identical items of plant in detail with the others witnessed on a random basis.

Verify the system security access.

Verify that all safety-related functions perform to that specified, eg plant shutdown on fire condition.

Verify all plant restarts according to that specified after building power failure and local power failure.

Witness all power meter data-points to ensure that they match the meters.

Ensure that trend logs are used when witnessing points in order to monitor the performance of control actions.

Verify the handover of all operating manuals and system documentation.

Verify the handover of backup copies of software.

Verify the completion of any specified system operator training.

## **4.16 BMS - POST HANDOVER CHECKS: (Edited from NES clause A32 152.000 / W60 360.050)**

Ensure that the following post-handover checks are performed:

Global level checks

Internal air temperature.

Relative humidity.

Energy consumption (ensure that the pulse-input counters match the meters).

Check that each of the above meets the specified requirements.

System level checks

Control set-points. Check that the set-points in question are correct and appropriate for the actual operating conditions.

Control loop settings. Check that the control loop settings result in accurate and stable control.

Occupant controls. Check that occupant controls work correctly.

Sub-system/component level

Dampers and valves. Check that there are no dampers and valves that are jammed and that they operate as intended

## **4.17 COMMISSIONING PLANT ITEMS AND OTHER SYSTEMS:**

Where no CIBSE or BSRIA manuals are published that cover the commissioning of specific plant items or other systems submit detailed proposals and comply with the manufacturers' recommendations for setting to work.

## **4.18 INSTRUMENTS AND GAUGES:**

Ensure instruments are correctly calibrated. Record details of instruments on record sheets.

Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing.

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## **4.19 AIR SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE 3/89.3:**

Keep a systematic record of commissioning results and distribute as indicated.  
For air systems.

A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.

Use record sheets as described in BSRIA Application Guide 3/89.3 Commissioning of air systems in buildings.

## **4.20 WATER SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE 2/89.3:**

Keep a systematic record of commissioning results and distribute as indicated.  
For water systems

A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.

Use record sheets as detailed in BSRIA Application Guide 2/89.3, Commissioning of water systems in buildings.

## **4.21 COMMISSIONING OF ELECTRICAL INSTALLATIONS:**

Ensure all electrical installations associated with the system are tested and commissioned before any plant is run.

Carry out electrical checks listed in CIBSE Commissioning documents :-

Series A Air Distribution Systems - A1.5

Code W:1989 Water Distribution Systems - W1.7

## **5. PERFORMANCE TESTING**

### **5.1 SYSTEM DEMONSTRATION:**

Demonstrate the performance and control sequence, including the operation of all safety devices, of installations including single, standby, multi-duty plants and systems, and of plants specified for future use.

### **5.2 TESTING OF RESIDENTIAL VENTILATION SYSTEMS:**

Demonstrate the performance of residential ventilation systems through performance testing and installation checks in accordance with BS EN 14134.

### **5.3 PERFORMANCE TESTS, CAPACITY TESTS AND ENVIRONMENTAL TESTING:**

Carry out performance and capacity tests and environmental testing for all systems and in all areas of the building to prove and demonstrate the performance of the systems and plant item duties.

Undertake Specific fan power validation (SFPv) tests on all air handling systems in accordance with BS EN 13779:2007.

For environmental testing, the minimum requirement is to test each room using the BMS (unless stated otherwise in Y51sch2) for at least 48 hours during which period the temperature and Humidity (if controlled) set points must be varied at least twice to prove the correct responses of control systems and plant. Temperature / humidity logs shall be provided as a record of the testing.

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Apply artificial loads / use calibrated data loggers or chart recorders (independent of the BMS) in those areas detailed in the scope of works, or where indicated in schedule Y51sch2 or otherwise provide test arrangements to simulate the full range of operating conditions and duties.

Undertake system proving during the defects period by recording, evaluating and reporting on the seasonal performance of the systems against their design values. Ensure that both summer and winter maximum and minimum conditions are covered by the test results.

Carry out ambient air quality tests in accordance with BS EN 13528-1 and BS EN 13528-2 as scheduled.

Carry out measurements of sound or noise levels in all internal and external areas of the building or project to demonstrate that the designed values are being achieved or not exceeded as appropriate.

## 5.4 CONTROLS DEMONSTRATION AND VERIFICATION:

Demonstration and verification that the controls systems are fully operational, commissioned and deliverables have been made shall include, but not be limited to, the following:-

- : Demonstration of operation of software prior to installation
- : Audit of cabling and hardware installation
- : Demonstration of physical and logical integrity of system, including demonstrating that sensors and actuators correctly connected and addressed.
- : Demonstration of control actions, including operation of all safety devices
- : Demonstration of sensor calibration
- : Demonstration of successful system software commissioning, including reloading software and documented commissioning data from media and subsequent satisfactory operation.
- : Verification of specified graphics
- : Verification of satisfactory training of client's staff
- : Verification of the handover of all specified operating manuals, documentation and drawings
- : Verification of handover of back-up copies of software
- : Verification of handover of consumable spares

## 5.5 RECORDERS:

During performance, capacity and environmental testing provide recorders as necessary to demonstrate the system performance.

Following completion provide and maintain on free loan portable at least three seven day space temperature and relative humidity recorders, together with adequate charts.

Provide other recorders as agreed with the engineer.

## 5.6 RAINWATER SYSTEMS:

Demonstrate by flow tests that the systems give satisfactory performance.

## 5.7 SANITARY SYSTEMS:

Comply with performance tests given in BS EN 12056 – 2 - 2000.

## 5.8 COLD WATER / BOOSTED COLD WATER SYSTEMS:

Demonstrate and record that outlets supply adequate rates of flow.

## 5.9 HOT WATER SYSTEMS:

Demonstrate and record that outlets supply adequate rates of flow and the water temperature reaches 50°C within 30 seconds of fully opening the tap at the furthestmost outlet in the system.

## 5.10 FIRE FIGHTING SYSTEMS:

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Comply with requirements of the local Fire Authority and comply with the commissioning / setting to work requirements as set down in BS9990 and BS 5306-1 (Hose reels) for non automatic fire-fighting systems.

Dry Riser System; undertake flow and pressure test at the highest outlet .of a flow of 25l/s at a running pressure of 4 bar or as agreed with the fire brigade. On each valve outlet below highest outlet undertake full bore flow test to prove no impedance to valve outlet flow

Wet Riser System; Undertake flow and pressure test at each outlet of 25l/s at a running pressure of 8bar. Or as agreed with the fire authority.

Where requested by the engineer carry out proving test of the riser's intermediate isolation valves and pump suction and delivery valves. Where the valves are monitored undertake proving test of the monitoring system by means of closing each valve and witnessing the alarm signal at the central panel location.

Wet riser storage tank infill main where installed undertake flow test utilising inline flow meter. Carryout proving test on the open and close operation of the storage tank infill float valves and prove operation of the storage tank high water level and low water level tank alarms and witness alarm signal at the alarm panel

On each pump undertake flow and pressure proving test utilising pump back to tank test line

Undertake pump automatic start test by lowering system pressure to below pump start pressure Test to be undertaken to each pump simulating standby pump operation by isolating lead pump and lowering system pressure..

Witness alarm signal of pump starting at alarm panel.

Simulate pump failure to prove pump failed signal on system alarm

On diesel pump set undertake '6 crank test' to simulate diesel pump failed to start signal.

## 5.11 HYDRAULIC SYSTEMS:

Comply with requirements as indicated.

## 5.12 GAS SYSTEMS:

Comply with the requirements of the local Authority.

## 5.13 SILENCERS AND ACOUSTIC TREATMENT:

Demonstrate by measured tests that noise criteria indicated have been achieved.

## 5.14 ACOUSTIC ENCLOSURES:

Demonstrate that measured air leakage complies with scheduled values.

## 5.15 PERFORMANCE TEST RECORDS:

Keep a systematic record of tests. Distribute records as indicated in Section A 33.

## 5.16 FINE TUNING:

Carry out fine-tuning as required by the engineer.