WATER SEGREGATION WORKS SPECIFICATION

PHASE 1
PENTLAND WING/1985 BUILDING

PHASE 2
CAIRNGORM WING/1974 BUILDING

CENTRE FOR ECOLOGY & HYDROLOGY

BUSH ESTATE
PENICUIK
EDINBURGH
EH26 0QB

August 2019

The Parties/Site/Scope of Work

Names and Addresses

Client/Project Manager/Principal Designer

Centre for Ecology & Hydrology
Bush Estate
Penicuik
Edinburgh
EH26 0QB

Consulting Mechanical and Electrical Engineers

Preston Lee Chambers Ltd
Ashley Court
Cannon Street
Hollingworth
Hyde,
Cheshire,
SK14 8LN

Contractor

The Contractor yet to be appointed to carry out the Works.

Access to and Possession or Use of the Site

Location of the Site

Centre for Ecology & Hydrology
Bush Estate
Penicuik
Edinburgh
EH26 0QB

Access to the Site

Access to the site shall be via the main entrance approached from Bush Loan Road.

Access to the building shall generally be via the reception area.

Under no circumstances shall the Contractors employees access any other areas of the building without the permission of the Project Manager.

Limitation of Working Space

The Contractor shall generally be limited to the following working areas of the buildings/site
- Pentland Wing
- 1985 Building

General site access shall be limited to access roads and car parking areas.

All access routes, and emergency escape routes shall be shared routes with site personnel, the Contractor shall therefore ensure they are available at all times.

Detailed method statements shall be provided by the Contractor to demonstrate the means of carrying out the work within the buildings, whilst the laboratories, offices, plant areas etc., remain in full occupation and the site is fully operational.

Description of the Works

The replacement of hot and cold water services to achieve water segregation between laboratory usage and domestic usage including modifications to associated services e.g., LTHW heating

All associated power and control wiring shall be

included. All associated builders work shall be included.

For a detailed description of the works refer to Specification Section 4.00 Description of the Works and Particular Requirements.

Documentation Form of Contract

NEC4 – Engineering and Construction Short Contract (ECSC)

Tender Drawings

The drawings which form part of the Tender Documentation are:

DRG. NO	TITLE	SCALE
Phase 1 Works		
P1493.T/M01	Pentland Wing - Ground Floor Level Hot and Cold Water Services Layout	1:50
P1493.T/M02	1985 Building - Ground Floor Level Hot and Cold Water Services Layout	1:50
P1493.T/M03	1985 Building - Roof Void Level Hot and Cold Water Services Layout	1:50
P1493.T/M04	Site Plan External Services Layout	1:200
P1493.T/M05	Schematic Layout Pentland Wing/1985 Building Hot and Cold Water Services	NTS
P1493.T/M06	Schematic Layout Pentland Wing/1985 Building Power and Control Wiring	NTS

Specification Arrangement

The Specification has been arranged as follows:

1 Contract Preliminaries

2 General Clauses

3 Standard Technical Specification

4 Description of the Works and Particular Requirements

5 Schedule of Tender Drawings

6 Technical Schedules

PRELIMINARIES

Quantities

Determine quantities from the drawing, specification and from a site survey as a basis for pricing the tender.

Approval

Approval (and words derived there from) means the approval in writing of the Project Manager, unless specified otherwise.

Comprehensive Tender

Pricing of the tender shall include for carrying out the entire works in accordance with the tender documents. Including amongst other things:

1. Labour and all costs in connection therewith including any out of normal hours working as required.

2. Commodities and all costs in connection therewith, including conveyance, delivery, unloading, storing, returning packings, handling, hoisting, lowering, cutting, fitting and fixing in position, removing protective measures.

3. Use of Plant, Tools and equipment.

4. Waste of Commodities.

5. Establishment Charges.

6. Overhead Charges.

7. Removal from site of redundant equipment

8. Profit.

Pricing

Costs relating to items which are not priced or do not appear in the Schedule of Rates will be deemed to have been included elsewhere in the pricing of the Schedule of Rates.

Contract Conditions/Appendices

The Contract Forms and Conditions of Contract will be the NEC4 Engineering and Construction Short Contract (June 2017)

Allow for the obligations, liabilities and services described in the contract against the clause headings set out below, taking into consideration the clause amendments described after some of the clause headings.

Contract Data

1. The Contractor's Offer and the Client's Acceptance
2. Price List
3. Scope
4. Site Information

Conditions of Contract

1. General
2 The Contractor's main responsibilities
3 Time

4 Quality management
5 Payment
6 Compensation events
7 Title
8 Liabilities and insurance
9 Termination and resolving disputes

Statutory/General Obligations

Generally

Safety, Health and Welfare

Comply with Enactments, Regulations and Working Rules relating to Safety, Health and Welfare of work-people and the Clients staff affected by or in the vicinity of the works.

Client's Requirements

Testing and Commissioning Generally

Use the permanent services and other power operated installations for testing and commissioning.

Client's Restrictions

Hours of Working

Generally working hours shall be as follows:-

Monday to Friday - 7.00am to 6.00pm

The Contractor shall include in his tender for the necessary number of personnel, working the hours required within the above times, to complete the works by the completion date(s) specified.

Should working ‘out of the above hours’ be required to complete the works by the completion date specified the Contractor shall allow for all cost implications in his tender.

Outside of the occupied periods, including weekends, additional security control will be provided by the Client for the duration of the Contract when the Contractor is working.

Strict compliance of the time periods will therefore be required in respect of work being carried out outside of the occupied periods.

The Contractor shall also liaise closely with the Clients building management outside of occupied periods.

Use of Site

Do not use the Site for any purpose other than carrying out the Works. Ensure all escape routes, stairs and occupied areas are free from any obstruction at all times.

Advertising

Do not display or permit to be displayed advertisements on the site without prior written consent of the Project Manager

Publicity

Do not take photographs, write articles for publication or cause to be issued or provide information for any publication or any advertisements, upon any subject or commodity used in

connection with the Works, without prior written consent of the Project Manager.

Occupied Buildings

The building, will be occupied during the hours stated for the hours of working.

The Contractor shall ensure no disruption occurs to the occupants in carrying out their normal working.

Use of Permanent Services and other Power Operated Installations

Prior to Practical Completion, do not use any of the Permanent Services and other Power Operated Installations for any purpose other than Testing and Commissioning of the Works and, for the Project Manager's Inspection of the Works.

Prevention of Accidents and/or Nuisance

Use of Explosives

Use of explosives will not be permitted.

Noise Control

Fit all compressors and percussion tools with effective silencers of a type recommended bythe manufacturers of the compressor tools. All noisy activities that may cause disruption to the occupants shall be carried out outside of the occupied periods.

Fire Precautions

Take all reasonable precautions to prevent loss or damage from fire.

Ensure existing fire alarm, halon and other protective system installations are isolated where activation of these will cause disruption, notify the offsite central station monitor accordingly where necessary.

Nuisance

Take all reasonable precautions to prevent nuisance from noise, smoke, noxious smells, dust, dirt, waste or any other cause arising from the carrying out of the Works.

Health & Safety

The Contractor shall operate a Health and Safety policy for the works and shall comply in particular with the requirements of the Construction, Design and Management (CDM) Regulations.

The Contractor shall be the ‘Principal Contractor’ in respect of the regulations and will be required to formulate and operate/manage the necessary Health & Safety plan for the project.

Prevention of Damage or Loss

Existing Buildings

Take all reasonable precautions to prevent damage to the shared access or adjoining buildings.

Cutting into Works

Do not cut into any part of the Works without prior written consent of the Project Manager in each instance.

Misuse of Commodities

Do not use commodities intended for inclusion in the Works for any temporary purpose.

Pre-Cleaning

Immediately prior to 'setting to work' any item of the Works:

1. Remove all temporary coverings and protective wrappings.

2. Clean out the interior of that item and clean the exterior of that item and all other parts of the works involved in its operation.
3. Adjust, ease and lubricate all moving parts involved as necessary to ensure easy and efficient operation.

Ensure cleanliness and ease and efficiency of operation prevail prior to and during each time the Works is 'set to work', until Practical Completion of the Works.

Public and Private Services

Notify all Service Authorities of proposed Works before commencing site operations. So far as is reasonable, ascertain location of services or confirm that none exist in the vicinity of the Works.

Notwithstanding any information provided by the Project Manager.
Protect, uphold and maintain all services. Do not interfere with their operation without the consent of the Service Authorities or Private Owners as appropriate and the Project Manager.

If any damage results from the execution of the Works, immediately:

1. Notify the Project Manager and appropriate Service Authority or Private Owner.

2. Make arrangements for the work to be made good immediately to the satisfaction of the Client, Service Authorities or Private Owners as appropriate.

Maintenance of Roads

Keep approaches to the site clear of mud and debris.

Ensure that no damage is caused to public roads and footpaths by site traffic.

Make good any damage caused by site traffic or site operations to the Client's private roads and footpaths.

Adjoining Property

Take all reasonable precautions to prevent damage to adjoining properties or site areas.

Security

The buildings are secure buildings and security systems and procedures are in place. Comply with the ‘booking-in’ procedure of the Client via Reception and observe all security requirements.

A full list of personnel to be employed on the works shall be provided by the Contractor prior to commencement of the works.

No services disruption, interruptions or alterations shall be allowed without the prior written approval of the Project Manager

Management/Administration Procedures

Progress

Prepare a comprehensive programme chart for the Works including the detailed co-ordination of all sub contract works.

Submit

Submit two copies of programmes to the Project Manager within one week after receipt of order and keep one copy on site.

Submission

Submission of programmes will not relieve the Contractor of his obligations to apply in writing for instructions as required by the Conditions of Contract.

Progress

Receipt of programmes by the Project Manager will neither affect the 'Date for Completion' or any extended time previously fixed by the Project Manager, nor relieve the Contractor of his obligation to complete the Works on or before the said 'Date of Completion' or any extended time previously fixed by the Project Manager.

Monitoring

Record progress on a copy of the programme chart kept on site. Update or re-draft if any circumstances arise which affect the progress of the Works and submit copies of all revisions to the Project Manager.

Site Meetings

Hold Site Meetings when required by the Project Manager. Attend such meetings and inform Sub-Contractors and Nominated Sub-Contractors when their presence is required.

The Project Manager will prepare the agenda, chair the meeting and prepare and distribute the minutes.

Day works generally

Provide labour, plant and materials returns weekly to the Project Manager after giving adequate notice of particular work to be recorded.

Site Engineer

Provide a competent person on site at all times throughout the execution of the works including times for delivery of materials, sub-contract elements and any out of normal hours working, etc.

Resources/Temporary Works and Services

Generally

Inform the Project Manager of the intended siting of all spoil heaps, temporary works and services.

Maintain existing live services on or over the site.

Ensure that walkways and means of escape for employees around the site of the Works are adequately indicated, designated, protected and provided with appropriate temporary lighting.

Temporary Works

Hoardings, Gantries and the like

Provide temporary fencing, hoardings, screens, fans, planked footways, guard rails, gantries and the like, as may be necessary for protecting the public and others, for the proper execution of the works and for meeting the requirements of any local or other Authority.

Temporary Services

Water

Use the building existing permanently connected water supply within the building as agreed with the Project Manager, extended as required by the Contractor.

Electricity

Use the building existing permanently connected electricity supply within the building as agreed with the Project Manager extended as required by the Contractor.

Lighting and Power

Provide all equipment for lighting and power for the Works and make temporary arrangements for distributing about the site. Include for appropriate standby generation for periods when power is completely isolated.

Electrical Installation Standards

Comply with current I.E.T. Wiring Regulations (BS7671: 2008 amendment 2: 2015), where applicable to Site Services, and with the British Standard Code of Practice, CP 1017.

Provide Certificates of Compliance with HSE Regulations for all portable tools.

Labour/Plant

Plant Costs

Provide all plant, tools, equipment and vehicles for the execution of the Works.

Contractor's Site Accommodation

The Contractor will be allocated a suitable space adjacent to the building for the location of site accommodation to include office, mess room and storage.

Use of Toilets

The Contractor will be allowed use of an allocated toilet within the vicinity of the works, on completion of the works the Contractor shall ensure the allocated toilet is returned to its original condition.

Protecting/Cleaning/Drying/Completing

Protecting the Works

Security

Safeguard and protect the site, the works, materials and plant from damage and theft.

Take all reasonable precautions to prevent unauthorised access to the site and the works and from the Site to Adjoining Property.

Protect

Protect the Works against weather and protect unfixed materials and goods against weather or other casualties.

Note that weather shall be deemed to include, amongst other things, the harmful effect of direct sunlight, or other forms of exposure to the elements, or other casualties.

Cleaning the Works

Cleanliness

Remove rubbish, protective coverings, casings and debris daily and generally keep the Site and the Works clean and tidy for the duration of the Contract, and at Completion of the Contract.

Ensure all areas not allocated to the Contractor for working are clean and clear for use by the occupants of the building at the start of any occupied period.

Drying the Works

Control

Control the drying and the humidity of the Works and the application of heat to prevent:

1. Blistering and failure of adhesion

2. Damage due to trapped moisture

3. Excessive movement

And to provide suitable working conditions for all trades.

Work at Completion

Remove

Remove all temporary markings, coverings and protective wrappings.

Clean

Clean the Works thoroughly inside and out, removing all splashes, deposits, rubbish and surplus materials. Clean down all plant and equipment.

Painted Surfaces

Touch up minor faults on painted surfaces, carefully matching colour and brushing out edges. Repaint badly marked areas back to suitable breaks or junctions.

Moving Parts

Adjust, ease and lubricate all doors, windows, drawers, ironmongery, appliances, controls and other moving parts as necessary to ensure easy and efficient operation.

Security at Completion

Leave the Works secure with all accesses locked. Account for all keys and hand over to Client with itemised schedule, retaining duplicate schedule signed by Client as receipt.

GENERAL CLAUSES

Regulations

The works to which this Specification relates must comply with the following current regulations:

This specification.
Health and Safety at Work Act.
The Asbestos Regulations.
Local Authorities By-Laws and Regulations.
Water Supply Authority's requirements.
Electricity Supply Authority's requirements.
Gas Supply Authority's requirements.
Loss Prevention Council Rules, (Formerly Fire Officers Committee).
Any other Special Licensing Authority's requirements.
Appropriate British Standards and Codes of Practice.
Regulations for Electric Installations.
Gas Safety Regulations.
Institution of Gas Engineers & Managers (IGEM) Standards
Factories Act.
Clean Air Act.

For appropriate instructions, give notification of any revisions to the foregoing as they are published.

Pay all charges made by any Authority approving any relevant part of these works.

Resources, Temporary Works and Services to be provided by the Sub- Contractor in Constructing the Sub-Contract Works

Supervision

Keep on site throughout the duration of the Contract works a competent person to act as your representative and to receive such instructions as are necessary for the execution of your obligations. Attend Site Meetings when requested. Control, plan and manage the works and all Contractors.

Planning

Plan the construction of the works before the work commences. Allow sufficient time to allow access to be provided for the installation of large items of plant and equipment or lengths of pipework, ductwork or cable etc.

STANDARD TECHNICAL SPECIFICATION
Standard Specifications

Supply, on loan only to the Project Manager's representative of the works, one copy of each British Standard Specification, Code of Practice & other Standard Specifications referred to in these Documents.

Roads

Provide as necessary, all temporary roads, tracks, crossings and hard-standings for your own exclusive use.

Buildings and Security Measures

Provide as necessary temporary sheds and offices for your own exclusive use.

Telephones

Provide as necessary temporary telephones for your own exclusive use. Pay all charges for your exclusive facilities.

Water, Lighting, Electric Power and Fuel

The Contractor will be provided with water, lighting, electric power & fuel in accordance with the Contract Preliminaries. Provide all other water, lighting, electric power & fuel as necessary for the installation & completion of the Contract Works, together with the means of supply, generation, storage, distribution & use, as required.

Operation of Plant etc.

Prior to Practical Completion, ensure that working plant is operating correctly. Provide your own skilled personnel to attend the plant etc., while working, together with specialist personnel as necessary.

Damage due to Frost

Make good at your own expense damage caused by frost to any part of the Contract works. Hand over completed systems either in operation or completely drained as instructed by the Project Manager

Asbestos

Do not use products that contain Asbestos.

Warning Note:

In the case of materials to be dismantled, determine whether asbestos is present prior to commencement.

Practical Completion

Before the Contract Works are included in a Certificate of Practical Completion, the Contract Works, or any such part as is referred to in the Certificate, shall be complete. The completion shall include setting to work, testing and commissioning, including proving the performance is in accordance with the Specification, of all items included in the Certificate, and full adjusting and balancing, in as far as is possible without the building being occupied, or the system being subject to a full climatic cycle, subject to the approval of the Project Manager.

After the installation has been shown to meet the commissioning requirements, the Project Manager may call for a further operation of the plant in evaluating the performance of an installation. Be prepared to operate the plant, the cost for which will be reimbursed.

STANDARD TECHNICAL SPECIFICATION

Training of Client's Personnel

Provide experienced personnel to instruct the Client's personnel in the operation, maintenance and servicing of all the installations. Give instructions for a period of two working weeks before the Contract Works are handed over.

Obligations after Practical Completion

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

1. A prompt call-back service, available at all reasonable times, to attend to any faults.

2. Carry out a final test at the end of the Defects Liability Period to demonstrate to the Project Manager that the Contract Works are operating efficiently and that all components are functioning correctly.

Carry out all work using competent, trained personnel, and except where made necessary by abuse, misuse or negligence by other than the Contractor, make no charge to the Client.

Notwithstanding the foregoing paragraph, charge to the Client the net cost of replacement for life-expired disposable parts.

Design Services required from the Contractor

Generally:

Select materials and products capable of attaining the performances specified in the Schedules and ensure that the various components of the installation can be coupled together in a proper manner.

Provide Installation Drawings, as detailed later, to illustrate your requirements in this respect to the Project Manager.

Provide Builder's work Drawings, as detailed later, to illustrate your requirements in this respect to the Project Manager.

Respond, in such good time that the Completion of the Works will not be delayed by the directions given to the Project Manager.

Perform your duties in accordance with a programme to be agreed with the Project Manager.

Integration

Co-operate with the Project Manager in planning the installation before the work commences.

Take particular care to ensure that there is no obstruction of electrical services positions, cable routes, switch positions, mechanical services, pipework, access points and plumbing etc.

Arrange services in ducts so that the services are readily accessible for maintenance.

The routes of services and the approximate positions of the equipment and apparatus are shown on the Quotation Drawings. Attend such meetings as are necessary to enable you to provide the Installation Drawings which the Project Manager requires to enable him to discharge his duties in coordinating the design process. The meetings will be called by and be under the direction of the Project Manager.

The object of the meeting will be:

1. To establish the inter-relationship of services in such confined spaces as ceiling voids, ducts and plant rooms;

2. To allow adequate space for maintenance and access purposes;

3. To assist in the proper provision of Builder's Works Drawings.

Installation Drawings

Prepare and supply for issue, all detailed Installation Drawings (including wiring diagrams) before installation is commenced.

Inform the Project Manager before changing any component or detail of installation shown on the Quotation Drawings, or described elsewhere in these documents. At the same time, notify the Project Manager of the total effect of these changes, including the design parameters of the system & their effect on power requirements, cable sizes, performance of rotating machines & ductwork or pipework resistance's etc.

Supply two copies of each drawing for inspection by the Project Manager, and if required, two copies of each subsequent amendment. When agreement has been reached, issue 2 further copies of the drawing.

Issue copies of drawings to those of your suppliers and Contractors affected by the drawings.

You may use any of the Quotation Drawings to meet the requirements of this Clause. Clearly mark them as Installation Drawings incorporating your own title block and referencing and accept full responsibility for them as such.

Allow in your programme for the preparation and obtaining approval of drawings, time to make any necessary amendments. Allow 14 days for drawing approval.

Definition of Approval

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

The Project Manager will approve the overall layout of plant & equipment, ducting, pipework, cabling, trunking, conduit etc. shown on the Installation Drawings & their general location as well as the type & size of these items in so far as they conform to the Quotation Drawings.

The exact position in the Works of the above items relative to grid lines, floors, beams, ceilings, walls, & other structural items & any other services is your responsibility & the Project Manager's approval does not absolve you from the necessity of checking these items.

Note also that approval of drawings will not relieve you of your responsibility for complying with the Specification.

Builder's Work Drawings

The Contractor shall, upon receipt of the instruction to commence work, or signing of the Contract, whichever the sooner, commence production of the builders work information detailing the positions of all holes, chases, ducts, trenches, manholes, plinths, bases, building in requirements for brackets or inserts, cut-outs etc. and all related making good requirements.

All builders work shall be carried out by the Main Contractor.

Forward two copies of these drawings to the Project Manager in such good time as to allow the Project Manager to meet the requirements of the drawing issue programme.

STANDARD TECHNICAL SPECIFICATION

Site Record Prints

Throughout the execution of the Works, keep on the site a complete set of up-to-date prints marked up with "As Installed" details. Make these prints available at any time to the Project Manager.

"As-Installed" Drawings and Diagrams

Unless otherwise agreed, the Contract Works, will only receive a Certificate of Practical Completion, when you have issued to the Project Manager the final "As-Installed" drawings and diagrams. These shall consist of:

Two compact discs.
Two sets of good quality paper prints.

Quotation drawings may be obtained from the Project Manager in DWG format.

These shall be amended to bring them into line with the works as fixed for submission to the Project Manager.

Four weeks prior to Practical Completion, send one set of paper prints of the "As-Installed" drawings and diagrams to the Project Manager for approval of format and general content. Allow 14 days for approving.

As-Installed drawings and diagrams shall clearly show the following, in as far as they are the subject of the Contract Works:-

1. The layout, location and extent of all piped services showing pipe sizes, throughout together with all valves for regulation, isolation and other purposes, shown numbered in accordance with the actual installation.

2. The layout, location & extent of all air ducts, including those formed in builder's work or otherwise outside this Contract but forming part of the systems, showing all dampers and other equipment, grilles, or other terminal components.

3. Single line & schematic wiring diagrams for the whole of the Contract works showing all terminal references & cable sizes.

4. The layout, location and extent of all electrical plant, cable, cable trunking, conduit, distribution boards, switches and outlets which form part of the Contract Works, including dimensioned layouts of all concealed work.

5. The layout, location and extent of all plant, cable, cable tray, trunking conduit, switches, outlets, terminals & indicators & alarms of all ancillary communication, detection, alarm & control installations which form part of the Contract Works, including dimensioned layouts of all concealed work.

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

7. The detailed general arrangement to one twentieth scale, of boiler rooms, tank rooms, and other plant spaces, including the location, identity, size and details of each piece of plant and equipment.

8. Manufacturer's drawings showing the general arrangement and assembly of component parts of all machines and any pieces of equipment which may require servicing.

9. Flow diagrams indicating the principles of the arrangements and operation of each of the various services as related to central plant, other principle components and zoning

of distribution etc.

10. Diagrams illustrating the principles of application of automatic controls and of instruments, presented in combination with the foregoing, or separately, as agreed with the Project Manager.

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

12. Comprehensive diagrams showing in detail all power wiring & all control wiring within the Contract, or by others in accordance with detail provided by the Contractor including size and type of conductor used and identifying the terminal points of each.

Operating Manuals

Unless otherwise agreed, the whole or any part of the Contract Works will only be included in a Certificate of Practical Completion when you have issued to the Project Manager two copies of all manuals & operating & maintenance instructions in stiff back ring binders

Before the above mentioned final issue, send a proofed copy of the manual to the Project Manager for approval of format and general content. Allow 14 days for approving.

Include the following information in the operating manuals:

1. Index

2. General description of the installation, equipment used and method of operation of the installation.
3. Handbooks, maintenance instructions, drawings and spare parts list for all components, plant and equipment used in the Contract Works.

4. Line diagrams indicating the main features of the plant drawing attention to methods of setting equipment and safety precautions etc.

5. Schedule of routine maintenance complete with routine oil and grease points and recommended lubricants.
6. Schedule of periodic and preventative maintenance for specialized equipment.

7. Schedules of methods of adjustments, typical fault finding routines.

8. Wiring diagrams of plant, etc.

9. Service manual for all specialized plant giving all details as above.

10. Schedules of equipment and motors related to the “As-Installed” Drawings and giving names of manufacturer, serial number of plant, electrical supply and power rating.

11. Description of emergency action which should be taken in the event of breakdown of equipment. Telephone numbers of essential contacts shall be included.

12. Outline design data of plant.

13. Test and performance data.

14. Test Certificate.

15. In addition, and separate from the Operating Manuals, supply two sets of manufacturers' catalogues relating to specialised plant and equipment.

STANDARD TECHNICAL SPECIFICATION

Valuation of the Contract Works

Preparation of the Quotation

Prepare the Quotation from the information given in the Specification and the Drawings scheduled herein.

Take figured dimensions in preference to scale and accept details on large scale drawings in preference to those on small-scale plans.

Sub-Letting

State in the Appendices to these documents, names of all firms to whom you propose to sub-let portions of the work.

Alternative Makes

Where a particular manufacturer is specified, alternative makes of equal quality will be considered by the Project Manager. However, include in the Quotation for the makes specified and give quotations for alternatives in detail separately in the Appendices to these documents.

Builders Work

All Builders work will be the responsibility of the Contractor.

Adjustments to the Contract Sum

No addition will be made to the Contract Sum if you have failed to ascertain, before tendering, all the requirements for carrying out the works, which inspection of the Site or of the Specification, and Quotation Drawings would have disclosed.
No change will be made to the Contract Sum unless the variation is authorised by an instruction from the Project Manager.

Within 14 days of the date of issue by the Project Manager of any instructions varying the content of the Contract Works, submit quotations to the Project Manager giving full details showing how the price is made up.

Variations shall be valued in accordance with the Valuation Rules of the Contract, excepting that, where work is omitted, it shall be fully measured and the quantities priced at the unit rates included in the Bills of Quantities.

Valuation for Interim Certificates

At the time of every valuation of the works for Interim Certificates, submit to the Project Manager a statement showing:

1. The gross amount (including cash discount and retention) claimed in the current certificate;

2. The net amount received from the Contractor to date excluding contra charges.

STANDARD TECHNICAL SPECIFICATION

Materials and Products

General

The Contractor shall ensure all materials, goods and workmanship used in the works are of the highest quality and conform to current British Standard Specifications and recommendations of the respective current Codes of Practice including test pressures, methods of testing, etc.

The Electrical Installations shall be in accordance with the current edition of BS 7671 (Formerly the IEE Wiring Regulations).

No materials brought to site for incorporation into the Works shall be used for scaffolding, any other temporary purpose or misused in any way.

All materials, goods or workmanship considered by the Project Manager to be unsound, unacceptable and/or not in accordance with the Specification shall be immediately removed by the Contractor and properly replaced by the Contractor to the satisfaction of the Project Manager at the Contractor's own expense. Should the Contractor neglect or refuse to do this, the Project Manager shall have the power to employ other monies that may then be or shall become due to the Contractor.

The work shall, unless otherwise stated, be carried out in strict accordance with the recommendations of the manufacturers of the materials, plant and equipment to be installed.

The Project Manager may require the Contractor to submit correctly identified and documented samples of any materials or workmanship to be used in the Contract Works for his approval, and the Contractor shall allow for any charges he may consider necessary in complying with this condition. All materials and workmanship for which samples have been approved must conform in every respect with such samples, and any items not conforming to the approved standard shall be removed and replaced with new materials at the Contractors own expense.

Ordering

Order all necessary materials and products to complete these works immediately upon receiving instructions to proceed.

No delay to the practical completion, or completion of any part of the works by the delays in ordering of materials or products will be accepted.

To avoid any possible delays, submit details of alternative manufacturers or types of materials or product for consideration and instruction as appropriate.

Handling, Storage and Cleaning

Deliver, off load, store and transport about the works all materials and products in a manner recommended by the manufacturers.

The Contractor shall include for taking all necessary precautions to protect plant, building, materials and equipment from damage and theft during the execution of the Contract Works and shall be liable for such damage and theft.

Goods shall be ordered with protective packaging where practicable and these shall be maintained in their position for as long as possible.

The Contractor shall provide full protection for all equipment, plant, motors and materials, fixed or unfixed, to prevent mechanical damage, ingress of dirt, dust and/or moisture.

Precautions must be taken and all protection provided to safeguard the works during frost and inclement weather.

Store pipework and similar products on purpose-made racks and adequately support and prevent bending and distortion.

Seal ends of pipework and similar products with purpose made caps and plugs.

Protect electrical cables from physical damage and seal ends.

Where materials and products cannot be stored in dry buildings, raise them clear of the ground and adequately support, protect and cover to prevent any damage.

Adequately coat materials and products to prevent any damage by oxidation or chemical reaction; maintain this coating until ready for final finishing.

Any damaged items shall be replaced to the satisfaction of the Project Manager, at the Contractor's own expense.

The Contractor shall thoroughly clean out the interior of each item of the installation and plant immediately after the execution of any work on that item, to the satisfaction of the Project Manager.

Immediately prior to Practical Completion of the Contract Works, the Contractor shall thoroughly clean down the works in an approved manner, and ensure the installation, including all plant, is free from dust dirt, moisture and other foreign matter. The necessary Practical Completion Certificate will not be issued until this work has been approved by the Project Manager.

Suitability

Use materials and products which:

(a) Are suitable for the services and conditions of use normally expected to apply after the installation is completed.

(b) Are able to withstand the testing and commissioning conditions specified.

(c) Do not initiate mould growth, support vermin, contain animal hair, contain asbestos (see general clauses) or which support bacterial life.

(d) Are free from objectionable odours at normal working temperature.

(e) Do not suffer deterioration at the maximum temperature and under the specified conditions of use.

(f) Are capable of being applied to any of the base surfaces without causing damage or deterioration of the base.

(g) Are not a fire hazard or evolve dense or toxic fumes if subjected to excessive heat such as in a fire.

(h) when of similar type are made by the same manufacturer throughout.

VIBRATION ISOLATION

General

Include for all necessary vibration and noise absorption equipment as indicated on the drawings and all additional equipment necessary to achieve the following:

- Specified internal and external noise levels.

- Isolation of the structure from vibration generated by plant, i.e. compressors, pumps, fans, etc.

Isolation of Plant

All items of plant which generate vibration shall be isolated from the structure as required using:

- Spring Isolators consisting in general of a steel spring with a steel base plate and load plate.

- Isolation pads consisting of ribbed oil resistant neoprene combined with galvanized steel shims.

Connection to Plant

Pipework and ductwork connections to plant shall include suitable vibration isolation couplings; rated for the pressure, temperature and chemical contents of the fluids involved. In each case manufacturers installation recommendations shall be sought by the Contractor.

Pipework and Ductwork Supports

Supports for pipework and ductwork shall include suitable isolation components to limit transmission of vibration to the structure.

Where required spring hanger insert type supports shall be used consisting in general of a steel spring with cap enclosed in a steel frame. Care shall be taken to ensure thermal movement does not impair the performance of the insert.

3.1 INSTRUMENTS

General

Manufactured by one of the scheduled firms to meet the requirements of the performance data.

Use instruments of matching style and calibrated as scheduled.

Dial Gauges Materials

Use 100mm diameter bourdon pattern gauges.

Manufacture gauge cases from steel, finished black and with a chromium plated bezel; and:-

(a) Those mounted directly on to pipelines to have plain cases.
(b) Those for panel mounting to have flanged cases.

Clearly display the manufacturer's name on the dial.

Show the service (primary) calibration in clear black letters on a white background and use black pointers operated by the service conditions.

Where a secondary scale is specified show this in red letters, placed inside the primary scale.

Where scheduled use loose red pointers, which can be fixed by the removal of the front cover only to indicate a set working point.

Dial Gauges - Installation

Mount dial gauges vertically.

Dial Gauges - Cocks

Use chromium plated bronze cocks, with a plastic lever handle and union.

Thermometer Pockets

Use stainless steel thermometer pockets with 19mm screwed head.

Pockets shall be suitably located and installed at a sufficient depth to ensure a true reading of the fluid temperature.

Fill thermometer pockets with a suitable heat conductive grease.

Capillary Tubes

Use copper capillary tubes with flexible armoured sheath.

IDENTIFICATION

General

Identification marks and colours shall be provided on all pipelines to conform to BS 1710 and this specification.

Identification marks and colours shall be provided on all duct lines to conform to DW 144 and this specification.

Identification marks shall be provided on all electrical systems to comply with the regulations for electrical installations.

Use identification labels as scheduled and securely fix.

Plant and Equipment

In general on plant and equipment use identification labels manufactured from triple sandwiched plastic laminates in colours and dimensions as listed below and engraved with the identification marks as scheduled.

Pipelines

Identification marks and colours shall be provided to show directional flow, service content, line size and where applicable, line number.

For pipeline identification marks use non-water soluble self-adhesive plastics in the appropriate colours and sizes.

Plastic laminate labels shall be provided as follows:

General pipelines and equipment	-	White/Black/White label 50mm high x 75mm long

		20mm high figures
Firefighting pipeline and plant	-	Red/White/Red label 50mm high x 75mm long 20mm high figures
General Valves	-	White/Black/White label 50mm diameter 15mm high figures
Fire Fighting Valves	-	Red/White/Red label 50mm diameter 15mm high figures
Control Valves	-	Black/White/Black label 75mm diameter 20mm high figures

Duct lines

Identification marks and colours shall be provided to show directional flow, service content and where applicable zone identification.

For duct line identification marks use non-water soluble self-adhesive plastics in the appropriate colours and dimensions as recommended in DW 144.

Plastic laminate labels shall be provided as follows:

General duct line and equipment	-	White/Black/White label 50mm high x 75mm long 20mm high figures

On duct line dampers clearly indicate the commissioning set point.

Instruments

Plastic laminate labels shall be provided as follows:

General instruments	-	Yellow/White/Yellow label 50mm diameter 15mm high figures

Charts

General

Provide and affix where indicated charts listed below.

Mount charts of 3mm thick hardboard set in a hardwood frame and glazed with 1.5mm clear acrylic.

Valve/Instrument Charts

Valve and instrument charts are to show the following information:-

(a) Single line schematic of each system with each valve and instrument numbered as scheduled.

(b) give the following information for each valve:-

Valve No, Valve Type, System/Line No, Position, Open/Closed Setting.

(c) give the following information for each instrument:

Instrument No, Instrument Type, Service, Instrument Function, And Normal Set Point.

A schematic diagram of the gas pipework installation in accordance with the above shall be mounted by the entrance door to the plantroom.

Duct line Damper and Instrument Charts

Duct line damper and instrument charts are to show the following information:-

(a) Single line schematic of each system with each damper and instrument numbered as scheduled.

(b) give the following information for each damper:-

Damper No, Damper Type, Function, System, Zone, Normal Position, (Open/Closed Setting).

(c) give the following information for each instrument:-

Instrument No Instrument Type, Service, Instrument Function, Normal Set Point.

Danger and Warning Notices

Provide and fix any danger and warning notices as required to comply with any statutory requirements and with the regulations for electrical installations.

PAINTING AND ANTI-CORROSION TREATMENT

General

Except where fabricated to specify standards, apply a protective coating to all metal components as specified and/or as scheduled.

Clean, de-scale and de-grease all metal surfaces to be protected.

Painting

Use paints manufactured by one of the scheduled firms and in accordance with the manufacturers' instructions and to BS 6150.

Make good any splashing, spotting or staining or any damage caused by the painting operation.

Carry out all protective painting required by this specification.

Give all necessary advice and assistance on any decorative painting to be done by others on materials and products incorporated within this specification.

Metal Coatings

Use and apply metal coatings as specified and as scheduled, and in accordance with the manufacturer's instructions.
Complete where possible all welding, drilling, cutting, bending and all other work with a base material before metal coating.

Protection of Bright Machined Parts

Apply a protective film to all bright machined parts before dispatch to the works.

Do not remove unless required for installation, testing or commissioning purposes and in such cases reinstate protective coating upon completion.

Remove protective coatings at date of practical completion.

Properly repair any damaged protective coating or bright machined part, or where necessary replace damaged component.

External Metalwork

All external metalwork shall be provided with a factory applied galvanized finish prior to delivery. Cut ends shall be painted with two coats of 'Galvafroid' paint or similar.

FIXING TO BUILDING FABRIC

Firmly fix all building services components and equipment contained within this specification.

Use screws or bolts as specified when fixing to the building fabric.

Use plastic plugs, ensuring screws and plugs are properly embedded when screw fixing to solid brickwork, blockwork or concrete.

Use self-drilling anchors when bolt fixing to solid brickwork, blockwork or concrete.

Use bolts of sufficient length, a suitable spreader plate under the head, and a nut and washer when through wall fixing.

Use self-tapping screws when fixing to sheet metal, except in air duct lines.

Use clamps and adapters of 'Lindaptor' pattern, and installed in accordance with the manufacturer's instructions when bolt fixing to structural steelwork.

Do not cut holes in or weld to structural steelwork.

PIPED SERVICES

General

Installation of all pipework shall follow the details set out on the quotation drawings.

Use tube, fittings, joints and valves suitable for the appropriate services as scheduled.

Face and drill flanges to the scheduled pressure rating.
Pipework ends shall be protected at all times.

Pipework Materials

All piping and tubing used in the construction of the various plants described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects and shall be free from rust and scale

Standard steel pipes having nominal bore of up to 150mm shall be black mild steel heavyweight pipe to BSEN 10255: 2004.
Steel pipework over 150mm bore shall be of Class C black mild steel manufactured in accordance with BSEN 10217: 2005 with flanges to BSEN 1092.

Steel pipework for welding shall be supplied with plain ends beveled for butt welding.

Where pipes are required for screwed joints, they shall be provided with screwed taper threads to BS 21and BSEN 10226-1: 2004.

Steel pipes which are to be used 'black' shall be varnished externally throughout their length after manufacture, and shall be painted two coats of red lead oxide paint immediately after installation, including all fittings etc.

Light gauge copper tube in accordance with BS EN 1057, 'Yorkex' as, manufactured by IMI Yorkshire Copper Tube Ltd

The materials for piped services shall be in accordance with the following schedules and clauses and shall not be varied without prior written permission

Welded Joints

Welded joints on steel pipelines shall be in accordance with the following British Standards:

Oxyacetylene Welding:

0-17 Bar & up to 200°C	}	BS 2640 : 1982
or	}	Class II Oxyacetylene
17-24 Bar & up to 95°C	}	welding of carbon steel pipework
Over 17 Bar & over 95°C	}	BS 1821 : 1982
or over 25 Bar	}	Class I Oxyacetylene
or over 200°C	}	welding of ferritic steel pipework

Arc Welding:

0-17 Bar & up to 200°C	}	BS 2971 : 1977
or	}	Class II arc welding
17-24 Bar and up to 95°C	}	of steel pipelines
Over 17 Bar & over 95°C	}	BS 2633 : 1987
or over 25 Bar	}	Class I arc welding
or over 200°C	}	of ferritic steel pipework

Pipework and fittings shall have square plain ends, bevelled for butt welding. After cutting or welding, all scale shall be removed and all welded joints painted two coats of red oxide.

Welding shall only be carried out by skilled craftsmen who are in possession of a current AOTC certificate of competency issued by an approved authority (which shall be produced upon request) and have had a suitable period of experience for the class of work in which they are engaged.

Each welder shall be assigned a reference to be stamped on each weld. When general hydraulic tests of the completed systems are carried out, as detailed elsewhere, each weld shall be lightly hammered during the time that pressure is maintained. If any leaks occur at welds the portion of the weld near the leak shall be cut out and re-welded. Such leaks shall not be repaired by caulking or attempted fusion of the surrounding metal.

Should a considerable portion of the welded joints made by a particular operator be found to be defective all such welds shall be cut out and rewelded by another operator whose work has proved satisfactory.
During the progress of the Works, inspection will be made to ensure the quality of welding.

The right is reserved to instruct the cutting open of up to any 10 (ten) sections of pipework which include welded joints and to have these parts laboratory tested. If the test and inspection should prove that the welds are to the required standard, the Client will pay the costs incurred in the removing, testing and replacing the sections of pipework. If, however, the inspection and test show that the welds are found to be faulty in any respect, no costs or fees incurred by the tests shall be borne by the Client. If this result suggests

That the standard of workmanship on the whole of the rest of the welded work is below that required, the right is reserved to instruct the removal of the remainder of the welded sections in whole or in part, and have these sections renewed to conform to this Specification. In this case, no claim for the costs involved in removing and renewing these sections of the Works shall be allowed, whether such welds are found to be faulty or not.

The use of ultrasonic testing on welded joints in situ will also be an acceptable method of testing welded joints.

The Contractor shall include for the inspection and testing of all welding on site and/or at manufacturer's works.

Screwed Joints

Steel pipe having screwed joints shall be carefully reamed out before the plain end is screwed.

Screwed joints shall be BS 21 with taper external (male) threads and parallel internal (female) threads. Parallel external (male) threads on pressure gauge cocks and pressure gauges shall not be used without the approval of the Project Manager, and only then with the use of suitable washers or grommets compressed between the end of the parallel male thread pipe or connector and a shoulder at the bottom of the parallel female thread.

When making a joint the screw thread shall be coated with a white compound to BS 6956 Part 5 or BS EN 751-2 and hemp, all surplus jointing compound being finally cleaned off to leave a surface suitable for painting. P.T.F.E. tape may only be used with prior agreement of the Project Manager.

The joint shall be arranged so that on completion two or three threads are left showing.

Should a screwed joint prove defective under subsequent test, the section of pipework in question shall be removed and made good. Caulking will not be permitted.

Flanged Joints

Steel pipes having flanged joints to BS 10 or BSEN 1092 - 1: 2007 + A1: 2013 shall be prepared to suit the method of attachment required.

Pipes not galvanised shall be provided with flanges screwed or welded on for nominal bores of 50mm and below, with flanges welded on for larger sizes. Galvanised pipes shall be provided with galvanised flanges screwed for nominal bores of 100mm and below, and with flanges welded on prior to galvanising the pipe for larger sizes, or where specified for all sizes galvanised after manufacture.
Where flanges are secured by screwing, the threads on the tube shall be arranged to end at a point just inside the bore of the flange, so as not to interfere with the joint. After the flange has been screwed on, the tube shall be expanded into the flange by a roller expander.

Welding flanges shall be of the slip-on pattern with neck machined on face secured by welding both the neck and bore of the flange to the pipe, with the tube finishing 3mm inside the bore. Care shall be taken not to distort that machined face.

Flanges shall incorporate bolt holes drilled but not punched.

Flanges shall be joined with 1.6mm 'full faced' Klingerite gasket and bolts, nuts and washers or hexagon type. Bolts for BS 10 flanges shall be British Standard Whitworth type to BS 916. 435 N/m^2 minimum tensile strength. Bolts for BSEN 1092 - 1: 2007 + A1: 2013 flanges shall be British Standard metric to BS 4190, 400 N/m^2 minimum tensile strength. The gaskets will have graphite finish and no jointing paste will be used. All flange bolts shall be complete with a washer beneath the head and the nut with the bolt protruding two clear threads of the nut, suitable for the temperature/pressure conditions and as scheduled.

Remove bolts used for 'Cold Draw' after pulling up is completed and replace with bolts of normal length.

Copper Pipework Joints

All jointing of copper tubes shall be strictly in accordance with the fitting manufacturer's recommendations.

Use fittings from one manufacturer throughout.

Where capillary fittings are used, care shall be taken to ensure that the solder used is suitable for the temperature conditions of the system.

All jointing materials shall be manufactured from non-dezincifiable materials. End feed capillary fittings and lead based solders shall not be used, only tin/silver solder to be used.

All solder droppings and surplus flux shall be removed on completion of the joint.

During all jointing operations using capillary and brazing fittings, the fitter/plumber shall be accompanied by a competent assistant and suitable noncombustible mats shall be used to protect the building fabric and decoration. Every precaution shall be taken to prevent damage by scorching or fire and the fitters/plumbers shall be provided with two portable fire extinguishers for use in an emergency.

All fittings and jointing materials to be suitable for the temperature and pressure of the system.

The Contractor shall follow the manufacturer's recommendations for materials and jointing on chemical injection systems used for water treatment.

Jointing of Dissimilar Metals

Where dissimilar metals are connected together, appropriate means shall be taken to prevent galvanic action.

Connect copper pipelines up to 67mm to steel or iron pipework with a screwed female boss or tee on the latter and with a copper x male iron union adaptor.

Connect copper pipelines over 67mm on pressurized systems to steel or iron by means of a flanged joint.

Connect copper pipelines over 67mm on non-pressurized systems to iron by means of:

(i) A socket on the latter.
(ii) A caulked lead joint.
(iii) Reinforce the copper spigot with a purpose made caulking bush or a copper flange hard soldered on.

Fittings for Mild Steel Pipework

Screwed tees, bends and sockets for use with standard steel pipes shall be to BSEN 10255: 2004 'heavy grade'. Ends shall be provided with screwed taper threads to BS 21.

Malleable cast iron pipe fittings shall be to BS 143 and 1256 banded or beaded for reinforcement.
The screwed ends of the fittings shall be provided with parallel female and taper male threads to BS 21, the axis of threads being coincident with the true axis of the fittings. Where specified, threaded fittings shall be provided and shall be in accordance with BS 143.

Unions shall be manufactured with double gunmetal seats as the ‘Navy’ pattern, and must be positioned where accessible so that they may be sprung apart.

All changes in direction shall be proportioned so that the ratio between the centre line radius of the bend and the inside diameter of the pipe is not less than 1.5 to 1.

If bends and springs are formed on site, then cold bending by a hydraulically operated machine will be permitted for standard steel pipes having a bore of 50mm and less but larger pipes shall be bent hot. All bends shall be normalised by heat treatment after manipulation.

All sets and double sets shall be formed from long lengths of tube with as large a radius as possible and shall be free from distortion.

Where practicable, all fittings shall be of the easy sweep type. Branches shall be made using swept tees or branch bends except where an air lock is liable to form, i.e. tees on rising mains etc. where square tees shall be used.

Elbows shall be used only where the use of bends is impracticable and where written permission has been obtained previously.

Where standard fittings are not available for the duty required, reductions on the run and to the branch shall, in all cases, be made with reducing sockets, not bushes.

Reducing fittings on horizontal pipework shall be of the eccentric pattern fixed so as to give a smooth run to the crown of the pipe. Concentric pattern reducers shall be used on vertical pipework.

Fittings for Copper Pipework

Capillary and compression fittings shall be to BSEN 1254. All fittings shall be manufactured from materials being non-dezincifiable. Any fittings not in keeping with this requirement shall be replaced at no cost to the Client. Lead based solder shall not be used on end feed capillary fittings. Only tin/silver will be permitted.

Manufactured fittings shall be used where the pipework is on view, a mixture of fittings and pulled bends is not permitted. All branch connections shall be by purpose made tees either square or sweep to suit the application.

Where practical, fittings shall be of long sweep pattern. Where standard fittings are not available for the duty and sizes required, reductions shall be made with purpose made fittings.

Where light gauge copper tubes are pulled on site to form bends and offsets, the material used shall be as for adjacent straight lengths. Tubes having nominal bores up to 28mm may be bent cold but larger sizes shall be annealed before manipulation.

In all cases, tubes shall be loaded prior to bending with springs, low melting point alloys or an inert sand, care being taken that contamination of the tube material is avoided.
Where bending machines are used these shall have smooth clean guides and formers, any scored or damaged tools being rejected. Pulled bends with any deformity whatsoever resulting in the forming of this bend will not be accepted.

Where it is intended to use compression fittings on underground pipework, this shall only be allowed following prior approval and the fittings shall be of the type 'B' pattern.

Unions shall be manufactured from gunmetal and shall be in accordance with BSEN 1254.

All fittings and jointing materials to be suitable for the working temperature and pressure of the system.

The Contractor shall strictly follow the manufacturer’s recommendations for materials and jointing on chemical injection systems used for water treatment.

Pipeline Ancillaries

General

All valves, stopcocks and other ancillary fittings shall be suitable for the temperatures, working pressures and substance carried within that service.

All valves shall be as far as practicable of the same manufacturer and style to provide visual uniformity and assist maintenance.

Valves

Valves and stopcocks shall be as scheduled.

Strainers

Strainers shall be suitable for the working pressure and shall be screwed angle pattern on pipelines up to 54mm as scheduled.
Flanged cast iron on pipelines over 54mm as scheduled.

Automatic Air Eliminators

Bronze automatic air eliminators shall be provided with integral lock shield valve on inlet and check valve on outlet, manufactured to facilitate grit removal whilst in service.

Provide screwed female connections on pipelines up to 50mm; flanged inlet and screwed female outlet on pipelines over 50mm.

Provide integral 10mm hard soldered copper discharge pipeline.

Air Bottles

Use air bottles on steel pipelines and as scheduled.

Use 50mm bottles on pipelines up to 50mm.
Use line size bottle on pipelines over 50mm.

Punishes

Fabricate from 3mm thick mild steel plate, to give a large end diameter of 100mm and a small end diameter of 25mm with an included apex angle of 30 degrees. Weld a 25mm female screwed boss to the small end.

Pressure Relief (Escape) Valves

Use 3-way pattern boiler escape valves as scheduled.

Provide screwed female connections on pipeline up to 50mm.

Provide flanged connections on pipelines over 50mm.

Safety Valves

Safety valves for boilers, heating calorifiers and all other pressure vessels shall be provided irrespective of whether shown on the drawing or not.
Use combined pressure and temperature relief pattern valves as scheduled.

Pipeline Support

General

All pipework shall be properly supported and bracketed and must permit, where required, adequate free and/or guided movement due to the operating conditions applicable.

Particular importance must be made to the design and method of supports and brackets for pipework and associated equipment. The materials, construction, method of fixing, practicability and appearance of the brackets must be carefully considered.

Materials

Use materials and components, correctly sized for the pipelines and to the appropriate British Standards and as listed below:

On proprietary systems use supports as recommended by the manufacturers of the system. Where applicable, use the following:

- Copper alloy pipe ring pattern round base wall brackets on copper pipelines up to 54mm.
- Copper alloy single pipe rings on copper pipelines.
- Malleable iron single pipe rings on steel pipelines up to 50mm.
- Mild steel heavy series pipe clips on steel/iron pipelines over 50mm.
- 'U' bolts of mild steel.
- Cast iron pipe rollers on cast iron or steel carriages, pipe retaining hoops to be of mild steel.
- Mild steel screwed studding.
- Turnbuckles on adjustable hangars.
- Forged steel hanger sling rods.
- Copper alloy spherical washers.
- Malleable iron round back plates.
- Mild steel gang hangers with matching bridge pieces.
- Short lengths of standard mild steel channel section for one or two pipe hanger supports.
- Mild steel material for fixing components to building fabric, where appropriate.
- Copper alloy material for fixing components to building fabric, where appropriate.
- Take appropriate means to prevent electrolytic damage, where dissimilar metals are used.
- Steel components to be sherardized.
- Iron components to be protected with Zinc-rich paint.

Workmanship and Assembly

Take into account the size of the pipelines, their contents and materials of construction, the thermal and acoustic insulation, the vibration isolation components, the amount and direction of movement, the location of the pipeline in relation to the building fabric and other services and the need for access, when sizing the pipeline support system.

Full and proper care shall be exercised in the positioning and marking out of all brackets and supports. Brackets and supports shall be set out so that they do not obstruct the access to valves, flanges or fittings requiring maintenance.

Where several pipelines run parallel to each other, individually fix each pipeline to a primary support system consisting of gang-hangers. Each to have at least two firm connections to the building fabric, one close to each end.

Do not attach pipeline supports to any plant or terminal units.
Do not use branches as pipeline supports.

On pipelines over 54mm size, support at both ends valves or groups of valves.

Pipelines which are not subject to thermal movement may have their supports attached directly to the building fabric.

For hanger supports to drainage pipelines, incorporate a turnbuckle in the sling rod, or a suitable alternative to allow fine adjustment to be made to the pipeline gradient. Turnbuckles to be locked at the top by a nut.

Where chaired rollers are used, use mild steel hoops, bolted to the roller chair at each end, to retain the pipe.

When chaired rollers are used on copper pipelines, protect the pipelines with a sleeve of copper or nylon, wired to the pipeline at each end, and having a length sufficient to allow the sleeve to remain under the hoops at all temperatures.

Pipeline sleeves and pipeline guides will not be regarded as pipeline supports.

Where applicable, assemble pipeline supports to the sub-assembly sketches as scheduled.

Spacing

Space supports on pipework at not more than the following intervals:

	Steel Pipework		**Copper Pipework**		
Bore (mm)	Horizontal (m)	Vertical (m)	Diameter (mm)	Horizontal (m)	Vertical (m)
15	2.0	2.4	15	1.4	1.8
20	2.4	2.7	22	1.4	1.8
25	2.7	3.0	28	1.7	2.1
32	2.7	3.0	35	1.7	2.1
40	3.0	3.6	42	2.0	2.4
50	3.4	3.6	54	2.0	2.4
65	3.7	4.2	67	2.0	2.4
80	3.7	4.2	76	2.4	2.7
100	4.1	4.8	108	2.7	3.3
125	4.4	5.5	133	3.0	3.6
150	4.8	5.5	159	3.0	3.6
200	5.1	6.0			
250	5.8	6.0			
300	6.1	6.0			

In addition to the centers given above, supports shall be provided adjacent to all valves, bends, tees and flanged joints and other special components to prevent undue strain on the adjoining pipework and so that the components or sections of pipework may be removed, leaving the adjoining pipework adequately supported at the ends.

Vertical pipework shall be suitably supported at the base of the riser and at all intermediate levels. Branch circuit pipes shall not be used as a means of support for the riser main.

Space pipeline supports for proprietary pipeline systems at not more than the support intervals recommended by the system manufacturer.

Space gang-hangers at the support intervals appropriate for the smallest pipeline carried.

Thermal Movement

Proportion thermal movement in pipelines about the system by the provision of anchors at suitable points.

Generally make provision for thermal movement by changes in direction of the pipelines.

Carry pipelines which are subject to thermal movement on rollers or by supports incorporating a spherical pivot at its upper end.

When making branch connections to mains allow for the thermal movement of the main without putting strain on the branch. Where this cannot be achieved, anchor the pipework in suitable places and insert a purpose-made expansion bellows in the pipeline between the anchors.

Install a pipeline guide within two pipe diameters of the moving end of an expansion unit, with a second guide a further fifteen to twenty pipe diameters distant from the first.

Pipeline Assembly

Generally

Arrange assemblies to present a neat appearance and generally follow the lines of building fabric, neatly offset around piers, columns and other obstructions.
Group in parallel lines where practicable.

Ensure all vertical lines are plumb.

Be installed to facilitate natural venting and drainage.

Pipeline Spacing and Clearance

Space to give the following clearances. Note: these are the minimum acceptable spacings and therefore allowance should be made, if needed, for working requirements.

- between insulated or uninsulated pipeline and wall finish : 25mm

- between insulated and uninsulated pipeline and ceiling finish or soffit : 50mm

- between insulated or uninsulated pipeline and floor finish : 150mm

- between adjacent pipelines both uninsulated : 150mm

- between adjacent pipelines one insulated and one uninsulated : 75mm

- between insulated pipelines and adjacent ducting, conduit, trunking or cable : 25mm

- between uninsulated pipelines and adjacent ducting, conduit, trunking or cable : 50mm

- between adjacent pipeline both insulated Pipeline Grading, Draining and Venting : 25mm

Set out in such a manner as to facilitate:

- Draining and release of air

- Rapid filling and drainage

- Freedom from air locking

Grade horizontal pipelines as follows:

- Pipelines carrying liquids by gravity flow : 1.66% or as drawn

- Pipelines carrying liquids under pressure : 0.40%

- Pipelines carrying gases under pressure : level

Install drain points in the following locations:

- Accessible low points on the pipelines.
- Low points on heat transfer coil connections.

- Low points on heat exchangers, vessels and other water containing plant and equipment.

- On the branch side of isolating valves.

Install air bottles at high points on hot water heating systems.

Location of Joints

Unless provision for access has been made, do not form pipeline joints within the thickness of walls or floors.

Location of Pressure Gauge Points

Use a female screwed outlet on the pipeline and a gauge cock for pressure gauge points.

Locate pressure gauge points as follows:

- Where shown on the drawings.

- On suction and delivery sides of every pump.

- On connections to air/liquid heat transfer coils.

- On connections to heater batteries of storage and non-storage calorifiers.

- On point of entry of each pipeline into Plant Rooms.

Location of Temperature Tapping Points.

For temperature tapping points use a female screwed outlet on the pipeline and fit thermometer pocket.

Where thermometers are not fitted permanently, use a blanking plug in the open end of the pocket.
Generally insert pockets into pipelines at right angles to the pipeline axis. On pipelines up to 32mm size, the pipelines must be locally enlarged to at least 80mm size on the pocket or the pocket may be inserted at a bend or inclined to the pipeline axis.

At least 75mm of the thermometer pocket to be in contact with the pipeline contents.

Locate temperature tapping points as follows:

- Where shown on the drawings.

- On connections to air/liquid heat transfer coils.

- On connections to heater batteries of storage and non-storage calorifiers.

- On point of entry of each pipeline into Plant Room.

Locating Pipeline Ancillaries

Locate pipeline ancillaries in positions which will facilitate operation and maintenance.

Group together, where possible, ancillaries on adjacent pipelines.

Pipework Associated with Plant

To be in accordance with appropriate standards.

Pipework Associated with Pumps

Where scheduled use vibration isolating pipe couplings.

In general assemble pipelines around pump sets with a strainer on the suction side and a non-return valve on the delivery side.
Position isolation valves to allow individual pumps, strainers and non-return valves to be removed and replaced without draining down the systems and while allowing any standby facility to function normally.

Connecting Pipework to Plant and Terminal Units.

Make final pipework connections to plant and terminal units as follows:

- Up to 54mm by means of a union.

- Over 54mm with flanges.

Incorporate other similar joints in adjacent pipework in such positions so as to allow supply and return to be isolated and the valve/coil assemblies drained and dismantled.

Incorporate any automatic control valve together with the necessary ancillary isolating valves, regulating valves, drain cocks and air release valves with the pipeline connection to plant and terminal units as necessary.

Incorporate a strainer upstream of any automatic control valve, in such a position that it can be easily maintained.

Pipework Associated with Ancillaries

Take discharge pipelines from air bottles, automatic air eliminators and safety valves to a suitable point, and group together where convenient.

Vibration Isolation Pipe Couplings

Provide as fabricated by one of the scheduled firms from natural or synthetic fibre, to ensure compatibility with the pipeline service and conditions.

Reinforce integrally, as required, with a flexible non-metallic synthetic fibre.

Provide the operating unit in the form of a bellows with ends shaped for slip-on flanges.

With galvanised mild steel flange backing rings.

If required, use fairing pieces, restraining bends and strengthening rings.

Install flange bolts with bolt heads on coupling side of joint.

The coupling must not carry any weight from the equipment or pipeline to which it is attached.

Install with great care, to ensure no twisting, stretching, compression or other misalignment during installation.

Fit spacer pieces, in place of coupling, during any pipeline testing which may affect coupling.

Sleeves

Fabricate from the pipeline material, except in load bearing walls which shall be from cast iron.

In non-load bearing walls provide annular clearance of 50mm.

Ensure that sleeves do not protrude from the face of the building fabric except when passing through waterproof building fabric use flanged sleeves which protrude 100mm.

In occupied spaces, fit Zinc Alloy Die cast masking plates fixed with matching screws.

Caulk annular space with suitable material.

Do not impede the thermal movement by the sleeve, caulking or masking plate.

Guides

Fabricate from the pipeline material, ensuring that the annular space does not exceed 3mm.

Weld to plates or sections for bolt fixing.

Ensure freedom from rust or scale and finish with zinc-rich paint.

Anchors

(1) Fabricate from two slip-on flanges bolted together through a steel member and welded or hard soldered, as appropriate to the pipeline, the steel member being then firmly fixed to the Building structure.

Or

(2) Fabricate from heavy mild steel saddles, minimum 10mm thick x same width as pipeline, welded to the surface of the pipeline. Provide saddles with lugs for connecting to building structure.

Provide bracing to suit, where necessary, pipeline conditions and loads.

Use self-drilling anchors where structure is of concrete, or bolt firmly to structure.

Ensure freedom from rust or scale and finish with zinc-rich paint.

DUCTWORK

Metal Ductwork

General

Design, fabricate and install systems to comply with the specification for sheet metal ductwork DW 144 published by the Building & Engineering Services Association (B&ES) and subject to the clarifications and amendments listed below.

Materials and Fabrication Standards

DW 144
(See Ductwork Schedules)

Workmanship

Tools

Obtain and use the correct tools for the fabrication and assembly of the duct

lines. Take care to avoid tool marks or damage to duct line components.

Repair or make good protective coatings, or, where necessary, replace any damaged component.

Cleanliness

Inspect all duct line components and remove any foreign matter.

Assembly

Design, fabricate and install to ensure good air flow conditions and freedom from air turbulence.

Lay out in such a manner as to generally follow the routes as shown on the Sub-Contract drawings.

Arrange to present a neat appearance and generally follow the lines of the building fabric. Where practicable, group duct lines in parallel lines.

All vertical duct lines to be plumb. Neatly offset around pillars, columns and other obstructions.

Detail components to take into account transportation, access, handling facilities and the space into which they are required to fit.

Where practicable on rectangular ductwork use square-bends with turning vanes in preference to other patterns.

Supports

General

Design and install the duct line support systems to generally comply with the specification for sheet metal duct work DW 144 subject only to the clarifications listed below.

Carefully consider all aspects relating to suitability of materials, method of construction, and method of fixing to building fabric, practicability and general appearance to each situation.

Support System

Incorporate the following features in the design, fabrication and installations of the duct line support system:

- Use additional supports for less rigid components.
- Avoid contact of mutually destructive materials.
- Directly fix to the building fabric.
- Use where necessary expanding wedge anchors for fixing to concrete and other masonry or use fixing components that pass through the fabric.
- Use clamp-on brackets of the 'Lindaptor' pattern when fixing to the structural steelwork.
- Use vibration isolation components.
- Take any necessary measures required for acoustic insulation.
- Avoid fixing supports directly to duct lines or equipment unless, in the case of equipment only, special support lugs are incorporated by the manufacturer.
- Use felt, strip rubber or similar approved material between supports and duct lines to minimise vibration transmission.
- Use hardwood or similar approved material between supports and duct lines having thermal insulation with vapour barrier.
- Use nuts and lock nuts when coupling under duct angle supports to studding drop rods.
- Use gallows and other brackets fabricated from standard steel angles, channels and flats and welded together. Grind smooth welds on completion.

THERMAL INSULATION

Thermal Insulation General

The Sub-Contractor shall include for all thermal insulation work, which shall be carried out by an approved Specialist Thermal Insulation Contractor. Only skilled operators shall be employed.

The Thermal Insulation Specialist shall be acquainted with all of the conditions of the works, including Specification, programming, hours of working etc., and he shall complete the work within such a programme.

The thermal insulation work shall not be commenced, unless otherwise approved in writing, until the whole of the installation has been completed and tested as set out in the relevant pipework, plant section of the Specification.

The thermal insulation works shall be in accordance with relevant Codes of Practice and British

Standard Specifications, in particular BS5422: 2009.

The Project Manager reserves the right not to accept any work of inferior quality or badly finished work. All joints, surface finishes, edges and overlaps shall not be allowed if they are of an irregular and dangerous nature.

Submit for approval samples of insulating material and finish, and place no order for such materials, or commence any work, prior to receipt of such approval in writing.

Use non-combustible materials and ensure the works conform to the Class 0 spread of flame requirements of the Building Regulations when tested in accordance with BS 476 Part 7.

Form flexible insulation from materials which lack rigidity and tend to drape or conform to the surface against which they are laid.

Form rigid insulation from materials which are stiff and unyielding and which substantially maintain their manufactured shape unless constrained to
Do otherwise.

Insulant - Pipework

Insulation shall comprise 35kg/m^3 minimum density CFC free rigid phenolic preformed insulation sections with factory applied bonded reinforced aluminium foil vapour barrier.

The thermal conductivity shall not exceed 0.018W/mK at a mean temperature of 10^{o}C.

The insulation shall be Class O rated to the Building Regulations with or without facing.

Insulation thickness shall be in accordance with BS5422: 2001.

Rigid phenolic insulation inserts shall be included on all pipework supports.

Factory manufactured or site fabricated rigid phenolic foam insulation boxes shall be fitted to valves/fittings where specified.

Insulant - Rectangular Ductwork

Insulation shall comprise 35kg/m^3 minimum density CFC free rigid phenolic preformed insulation sections with factory applied bonded reinforced aluminium foil vapour barrier.

The thermal conductivity shall not exceed 0.018W/mK at a mean temperature of 10^{o}C.

The insulation shall be Class O rated to the Building Regulations with or without facing.

Insulation thickness shall be in accordance with BS5422: 2009

Rigid phenolic insulation inserts shall be included on all ductwork supports.

Insulant - Circular Ductwork

Insulation shall comprise 35kg/m^3 minimum density CFC free rigid phenolic preformed insulation sections with factory applied bonded reinforced aluminium foil vapour barrier.

The thermal conductivity shall not exceed 0.018W/mK at a mean temperature of 10^{o}C.

The insulation shall be Class O rated to the Building Regulations with or without facing.

Insulation thickness shall be in accordance with BS5422: 2009.

Rigid phenolic insulation inserts shall be included on all ductwork supports.

Insulant - Heat Exchangers, Cylinders, Buffer Vessels

Insulation shall comprise 33kg/m3 minimum density lamella mineral fibre slabs with factory applied reinforced aluminium foil facing.

Insulation thickness shall be 75mm, all corners and butt joints shall be sealed with 100mm wide self-adhesive aluminium foil tape.

Insulant - Water Storage Tanks

Insulation shall comprise 40kg/m^3 nominal density ridged phenolic foam insulation boards with factory applied reinforced aluminium foil facing.

Insulation thickness shall be 40mm, all corners and butt joints shall be sealed with 100mm wide self-adhesive aluminium foil tape.

Facings - Service Ducts, Ceiling and Floor Voids

(a) Pipework - Reinforced aluminium foil facing rated as Class O, butt joints shall be sealed with 50mm wide self- adhesive aluminium foiltape.

Ductwork - Reinforced aluminium foil facing rated as Class O, butt joints shall be sealed with 50mm wide self- adhesive aluminium foil tape.

(b) Fabricated sheet aluminium casings :-
- 0.6mm thick on pipework up to and including 150mm diameter.
- 0.8mm thick on pipework over 150mm diameter and on ductwork.
- 0.7mm thick on removable valve and flange boxes, insulation shall Be to the same thickness as the pipework insulation and shall be bonded to the inside surface of the box which shall be secured with quick release clips.

Thermal Insulation - Workmanship

Carry out thermal insulation work using one of the scheduled firms.

Do not apply thermal insulation to the base until the installation has been fully tested and all joints have proved sound.
Ensure the insulation work is of good quality and finished to a high standard. Apply the insulation material evenly in thickness and ensure the finish is clean and smooth.

Insulate each unit separately and do not enclose adjacent units together.

Ensure the clearance between lagged pipes is in accordance with specified pipeline spacing and clearance.

Apply insulants, facings, coatings and protection strictly in accordance with the manufacturer's instructions and this Specification.

Neatly finish joints, corners, edges and overlaps and, where possible, arrange overlaps to fall on the blind side. Ensure overlaps are neat and even, and parallel to the circumferential and longitudinal joints.

Unless otherwise scheduled, leave flanges and valves uninsulated and the insulation finished up to the projection with a neat bevel.

Where the pipe rings have segmental hardwood liners, carefully fit the insulant up to the liner and carry the facing across the pipe ring.

Ensure the finished vapour sealing is continuous and smooth, and in service is effective in preventing water vapour entering the body of the insulant.

In Plant room areas where a protection is applied to the base insulation of pipework, fittings and equipment, arrange the joints to fall blindside, the jointing being with either rivets through the finish or a suitable adhesive.

Protect standard 90 degree bends with pre-formed sections of the same material as the straight length, the bends being generally made from one piece.

Thermal Insulating Standards

(For Thermal Insulation Standards see Insulation Schedule - Section 6.03)

Thermal Insulation - Inspection and Testing

A performance test of thermal conductivity on the materials selected will be required. The tests will be carried out at either the manufacturer's works or at the National Physical Laboratory and shall be in accordance with the appropriate British Standard.
After the insulation has been applied, an inspection will be made to check the thickness, diametrically in the case of the curved surface and perpendicularly in the case of a flat surface. If further calculation demonstrates that the applied insulation will be less than the thermal conductivity specified, apply additional insulation to meet the specified values.

ELECTRIC MOTORS AND DRIVES

General

Manufactured by one of the scheduled firms to meet the requirements of the performance data and as below.

Supply motors and drives complete with keys and keyways.

Motors

Use motors of the ratings with enclosures and of the insulation class all as scheduled, and ensure they are capable of performing the scheduled tasks.

Select motors of the lowest speed possible with the tasks to be performed.

Select motors suitable for the electrical supply as scheduled.

Provide motors with a non-corrodible label attached adjacent to each bearing giving details of the lubricant to be used.

Fit motor bodies with a conduit entry terminal box or cable gland as required. All plinths will be built in by others, in such circumstances provide all necessary assistance.

Provide all information to enable supporting plinths to be built by others.

Mark on the motor casing the direction of rotation.

Motor Starters

Use direct on line starters unless otherwise specified.

In general, use single phase motors of a rating 0.18 kW and below.

Motor - Enclosures

In general, use motors of the classification IP44

TESTING AND COMMISSIONING

General

Include for the complete testing and final commissioning of the installation to the satisfaction of the Project Manager and in accordance with the CIBSE Commissioning Code, British Standards and Codes of Practice.

Permit the Project Manager or his appointed representative to have access at all reasonable times to such parts of the Contractors Works as may be necessary for the purpose of inspecting, examining and testing of materials, workmanship and performance of plant.

Provide, unless otherwise specified, all labour, materials, power, and fuel and test equipment for carrying out the tests. Tests shall be on site and/or off site as applicable to the tests specified.

Complete the testing and commissioning in three basic stages as follows:

Testing

Carry out all pressure tests which are necessary to bring the completed work up to a standard of 'static' completion.

Produce and issue Test Clearance Certificates which clearly indicate the tests carried out, the date of the test and the results.

Commissioning

Prove the engineering systems from the static completion state to fully operating one.

Include in the proving of a system all the system balancing and recording of test data and set points, together with the setting of the environmental conditions and recording test data against external conditions.

Commissioning Prior to Handover

Immediately prior to handover of the complete building the Clients representative, the Project Manager, the Contractor and appropriate Sub-Contractors will witness final acceptance testing of all engineering services. It is intended that spot checks will be taken on the installation being proposed for handover and compared with the test and environmental data obtained under Stage 2 commissioning. In the event that the spot checks are inconsistent with the test and environmental data, the element in question shall be checked in its entirety.

Give the Project Manager a minimum of 7 days' notice of intent to carry out on site and off site tests.

All tests shall be witnessed by the Project Manager or his representative together with the Contractor.

Rectify all defects and repeat tests all at no extra cost.

Leave no installation unattended during testing and commissioning whenever or wherever there is an inherent risk to the installation or building.

Carry out any additional tests as requested by the Project Manager during the defects liability period. Tests will only be requested by the Project Manager in the period if a

System is not performing as specified. Should it be found, after re-testing, that the initial tests were not in accordance with the performance specified, then any additional costs incurred shall be borne by the Contractor?

Costs associated with additional testing required by the Project Manager to alter the performance specification shall not be borne by the Contractor.
In the event of the works being incomplete and causing a postponement of any notified test date, the Contractor shall be at liberty to deduct all reasonable expenses incurred.

Test all plant, including standby equipment, to ensure that it is operating in accordance with the specified conditions, and also that it is functioning in accordance with the control and interlocking sequences specified, including emergency functions.

Carry out, as far as possible, the adjusting and balancing of the systems without the building being occupied or the system being subjected to a full climatic cycle. Finally adjust and balance to meet a full climatic cycle during the defects liability period.

Specialist Plant

Complete testing and commissioning of the following specialist plant:

(a) Gas Fired Boiler Plant

(b) Refrigeration plant and equipment

(c) Main control panel

(d) Automatic control installation

Where no test values are specified include for testing to the appropriate BS in accordance with the plant, equipment, etc., operating conditions.

Forward triplicate copies of all test certificates to the Project Manager.

Pipework and Associated Plant

Cleanliness

Take all necessary precautions to protect the system during installation as called for in the specification; allow for flushing through the entire system(s).

After flushing, chemically clean the heating water circulation systems in order to prevent corrosion and scale formations. Carry out this work immediately prior to the start of commissioning.

Isolate all items which may be affected by direct or chemical action during these procedures.

Sterilize the Hot and Cold water system in accordance with BS6700 and provide acceptable compliance certificates of cleanliness.

Hydraulic Testing

Pressure test the new complete installation to the pressure specified. Isolate or remove all safety valves, altitude or pressure gauges or, items of plant or equipment which may suffer damage, during such tests.

Maintain the test pressure for a period of one hour without undue loss.

Forward certificates of all the hydraulic test made on the site signed by the Contractor and by the Project Manager or his representative who witnessed the tests, and immediately after satisfactory conclusion of the tests.

Forward copies of the certificates to the Project Manager before any thermal insulation is applied.

Operational Testing

After the hydraulic tests have been successfully completed subject the installation to the correct operating conditions. The duration of this test shall be eight hours during which time all the pipework, plant and equipment shall be subjected to actual operating conditions. After this initial test allow the installation to return to ambient temperature and repeat the test.

Examine the installation to ensure that the correct expansion and contraction takes place. Inspect supports to ensure that their alignment is still correct.

Inspect all fittings, piping and equipment during the tests for leakage and other defects. Provide all skilled attention necessary during the test period to ensure that all controls are operating correctly.

Balancing

Balance all circuits by the regulation valves provided on a temperature and pressure basis. Utilising details of design temperatures at the various points of the system provided, check overall flow by measuring the pressure differences across the pumps and relate this to the pump manufacturers test curves. Adjust flow through the equipment to give the design temperature drop or rise utilising commissioning valves.

Include for all necessary pressure gauges and temperature tappings to enable the water circuits to be properly balanced and also to determine precise pressure losses across control valve, coils and all equipment.

Balance the system generally using the procedures outlined in CIBSE Commissioning Code W. Upon completion of the testing balancing and operating of the installation allow for taking temperature readings in each room and submit these in a fully tabulated schedule for comment.

Supply all necessary instruments to effectively test and commission the complete piping services and associated equipment and any additional instruments as may be reasonably requested.

Thermal Insulation

When requested carry out, at no cost, acceptance tests of thermal conductivity on a selected material, such tests to be carried out at the manufacturers works or at the National Physical Laboratory. Should the test show that the thermal conductivity is not appropriate to the thickness specified provide extra thickness based on the test value without extra costs.

Also provide extra thickness without extra cost should the Contract Administrator's tests prove that insufficient thickness of material has been installed.

Commissioning of Controls

The Contractor is responsible for the commissioning of the control's installation. It shall however be carried out by the controls manufacturer and in accordance with the following clauses:

- The Contractors responsibility for commissioning shall extend only for the duration of the Sub-Contract and defects liability period.

DESCRIPTION OF THE WORKS AND PARTICULAR REQUIREMENTS

- Inspect and check the complete electrical works associated with the automatic control installation whether installed by the Contractor or others to his detailed requirements.

  Include a check of power and control wiring, fuses, starters and isolators appropriate to the installed motors; setting of timers or time clock controls, setting of transformer output voltages, fittings of flexible electrical connections and provisions for earthing, bonding and screening as necessary.

- Advise the Project Manager of any site tests, & give 7 days' notice in writing of final tests so that they can be carried out in the presence of the Project Manager or his representative.

- Provide the services of skilled commissioning engineers, test equipment, tools and instruments for any tests and make good any defects at no extra cost.

- Test, calibrate, adjust, check and re-set thermostatic and automatic controls and provide all test certificates and calibration charts.

- Position all thermostats and controls and ensure that their calibration is appropriate for the control set point and within the control limits.

- Provide all necessary temperature and humidity records and charts and attendance so that records can be taken of the plant performance in such areas that the Project Manager may decide.

- Test all electrical equipment associated with the automatic controls installation and provide test certificates.

- Establish that the installation is covered by insurance prior to carrying out full performance tests under actual working conditions.

- Check the operation of all alarms, safety devices and plant interlocking by simulating fault conditions.

- During the defects liability period make several visits to the site and carry out thorough checks of the controls.

- Make such adjustments that are necessary to the controls installation under actual working conditions and report to the Project Manager, taking due account of variation due to occupancy of the building, seasonal changes, or variations in the operation of the mechanical plant under control, etc.

- Until the final check & adjustment has been carried out the Contract shall not be considered for final acceptance and the balance of retention funds shall not be released.

DESCRIPTION OF THE WORKS AND PARTICULAR REQUIREMENTS

SCOPE OF WORKS

The works comprise the replacement of existing hot and cold water services to achieve segregation between laboratory water usage and domestic water usage and provide fully compliant installation at the Centre for Ecology and Hydrology, Bush Estate, Penicuik, Edinburgh, EH26 0QB.

The water segregation works shall require the replacement of existing hot and cold water services to create the following dedicated hot and cold water services installations :-

- Laboratory system - hot and cold water services to laboratory sinks, fume cupboards and autoclaves.
- Domestic system - hot and cold water services to wash hand basins in toilet areas and laboratories, sinks in kitchen areas and cleaner's rooms, dishwashers and shower facilities.

The works shall be undertaken in two phases to minimise disruption to the CEH site comprising:-

- Phase 1 : Replacement of hot and cold water services in the Pentland Wing and 1985 Building
- Phase 2 : Replacement of hot and cold water services in the Cairngorm Wing and 1974 Building

PHASE 1

The existing LTHW heating installation shall require modification to accommodate two new unvented hot water storage cylinders.

The existing automatic controls installation shall be modified to control and monitor the new domestic hot water storage cylinders.

The works shall include all associated power and control wiring.

The works shall also include all associated builders work.

The Contractor shall undertake the work as Principal Contractor and will be required to comply with the duties this involves under CDM regulations.

The work will generally be carried-out during normal working hours in occupied buildings and will require careful consideration to the working methodology to ensure the building users are able to continue with their normal daily activities in a safe working environment.

Any interruption of services, disconnection and modification of systems etc., shall only be carried-out following discussion and agreement with the Project Manager and building users.

The Contractor shall ensure that all services are co-ordinated on site to avoid clashes with the building structural elements and existing/new engineering services.

The Contractor shall visit site during the tender period to ascertain the nature of any restrictions which may affect his tender as no claim for want or lack of knowledge in this respect will be considered by the Client at a later date.

The Contractor shall include within his tender for the provision of 'As-Fitted' drawings and Operating and Maintenance manuals.

The Contractor shall provide 2No. Paper prints of the 'As-Fitted' drawings.

The drawings shall also be submitted on compact disc using the current version of AutoCAD. The 'As-Fitted' drawings shall comprise the installation drawings and specification schedules fully updated to reflect the final installation.

Two copies of the Operating and Maintenance manual shall be provided, the manuals shall be A4 size and bound in a stiff backed binders. The format shall be in accordance with the BSRIA Application Guide January 1987 - 'Operating and Maintenance Manuals for Building Services'.

Draft copies of the 'As-Fitted' Drawings and Operating and Maintenance manuals shall be submitted for approval. A minimum of two working weeks shall be allowed for checking and approval.

It should be noted that the provision of 'As-Fitted' Drawings and Operating and Maintenance Manual is a requirement to be fulfilled before the completed installations can be accepted for handover and the works deemed to be Practically Complete.

Copies of the 'As-Fitted' Drawings and Operating and Maintenance Manual will be required to be included in the Health and Safety File and the document must be complete in order to achieve Practical completion.

The Contractor shall note that the works shall be carried out in accordance with the Construction, Design and Management (CDM) Regulations 2015, therefore all necessary method statements and risk assessments shall be produced and submitted for comment prior to commencement on site.

The Contractor shall note the works shall be carried-out in accordance with Approved Document L2 of the Building Regulations. The Contractor shall provide relevant information for the Building Log Book for the works executed in accordance with the requirements of L2.

The relevant information for the Building Log Book shall comply with CIBSE publications TM31 and be based on the CIBSE Building Log Book template.

The relevant information for the Building Log Book shall be submitted for approval and shall be available to the Client at handover.

STRIP-OUT WORKS

The Contractor shall include for dismantling and removal from site of all obsolete mechanical and electrical engineering services.

The works shall involve but not be limited to the strip out of the following:-
- hot water service storage cylinder
- electric water heaters and associated pipework and wiring
- pipework (associated materials), valves, fittings, supports, insulation etc.,

The full extent of the strip-out works shall be determined by site inspection

INCOMING MAINS COLD WATER SERVICE

The existing mains cold water service enters Room 1 in the 1985 Building as indicated on the tender drawings and rises to distribute generally in the roof void.

The existing mains cold water pipework installation shall be modified as follows:-
- the existing mains cold water supply from the entry point to the roof void plantroom shall be retained :-
- within the roof void plantroom the installation shall be modified to provide
    - cold feed to new unvented hot water storage cylinder - domestic system
    - cold feed to new cold water storage tank - laboratory system

- cold feed to existing heating pressurization unit

The remainder of the mains cold water services installation shall be replaced by a new copper pipework (Table X) distribution.

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

All pipework and fittings shall be flushed-out and chlorinated on completion of the works, the water specialist shall provide certificates for inclusion in the O & M manual.

All mains cold water pipework and fittings including valves and flanges shall be thermally insulated.

HOT WATER SERVICES - DOMESTIC SYSTEM

A new unvented hot water storage cylinder shall be installed in the roof level plantroom to provide domestic hot water to the following:-

• wash hand basins in laboratories
• wash hand basins in toilet areas
• sinks in kitchen/brew areas
• cleaners sinks

The new storage cylinder shall be mains fed complete with unvented kit, a de-stratification pump set shall be installed.

The new domestic hot water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - push-fit and compression fittings and flexible connections shall not be used.

New wash hand basins complete with pillar mixing taps shall be installed in the following rooms:-

Pentland Wing
• Room 105 : Radiation Lab
• Room 103 : Amfia Lab

1985 Building
• Room 27 : Chemistry Lab
• Room 26 : Wash Up Room
• Room 41 : Fresh Water Chemistry Lab
• Room 42 : Fresh Water Invertebrate Lab
• Room 44 : Fresh Water Prep Lab

Generally blending valves shall not be installed on wash hand basins (CEH requirement), the only exception shall be the disabled toilet in Room 114.

All domestic hot water outlets shall be fitted with ballofix isolation valves (adjacent WHB taps, sink taps, shower valves etc.).

All pipework and fittings shall be flushed-out and chlorinated on completion of the works, the water specialist shall provide certificates for inclusion in the O & M manual.

All domestic hot water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED HOT WATER SERVICES - LABORATORY SYSTEM

A new unvented hot water storage cylinder shall be installed in the roof level plantroom to provide domestic hot water to the following:-

• sinks in laboratories

The new storage cylinder shall be supplied with boosted cold water and shall include an unvented kit, a de-stratification pump set shall be installed.

The new domestic hot water services installation shall be installed in copper pipework (Table x).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push fit and compression fittings shall not be used.

All laboratory hot water outlets shall be fitted with ballofix isolation valves (adjacent lab taps, dishwashers, autoclaves etc).

All lab taps shall be fitted with Arboles UK Ltd (or similar approved) WRAS approved ant-syphon nozzles.

All pipework and fittings shall be flushed out and chlorinated on completion, the water specialist shall provide certificates for inclusion in the O & M manual.

All laboratory system hot water pipework and fittings including valves and flanges shall be thermally insulated.

MAINS COLD WATER SERVICES - DOMESTIC SYSTEM

The new mains cold water (domestic system) installation shall serve the following:-

- new cold water storage (break) tank providing cold feed to new booster set
- wash hand basins in laboratories
- wash hand basins in toilet areas
- sinks and dishwashers in brew areas
- sinks in cleaners rooms
- WC's and urinals

The new mains cold water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

New wash hand basins complete with pillar mixing taps shall be installed in the following rooms:-

Pentland Wing
- Room 105 : Radiation Lab
- Room 103 : Amfia Lab

1985 Building

- Room 27 : Chemistry Lab
- Room 26 : Wash Up Room
- Room 41 : Fresh Water Chemistry Lab
- Room 42 : Fresh Water Invertebrate Lab
- Room 44 : Fresh Water Prep Lab

All dead legs shall be removed including removal of branch tees and making good of existing mains pipework.
All mains cold water outlets shall be fitted with ballofix isolation valves (adjacent WHB taps, sink taps, WC's, shower valves etc.).

All new and existing pipework and fittings shall be flushed-out and chlorinated, on completion the water specialist shall provide certification for inclusion in the O & M manual.

All mains cold water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED COLD WATER SERVICES - LABORATORY SYSTEM

A new cold water booster set and break tank shall be installed in the roof level plantroom to provide boosted hot and cold water services to the following:-

- sinks within laboratories
- autoclaves within washrooms
- ice machine in washroom

The cold water storage tank shall comprise a two piece tank complete with drip tray mounted on a steelwork stillage with plywood base to support the tank.

The cold water booster set shall comprise a packaged dual pump (run-and standby) arrangement with control panel on a common base.

Boosted cold water shall be provided to serve the unvented hot water storage cylinder serving the laboratories, the unvented kit shall include a 3 bar pressure reducing valve.

Boosted cold water shall be provided to serve sinks, autoclaves and ice machines in laboratories and washrooms.

The boosted cold water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

All boosted cold water outlets shall be fitted with ballofix isolation valves (adjacent lab taps, fume cupboard taps, dishwashers, autoclaves etc.).

All lab taps shall be fitted with Arboles UK Ltd (or similar approved) WRAS approved ant-syphon nozzles.

All new and existing pipework and fittings shall be flushed-out and chlorinated, on completion the water specialist shall provide certification for inclusion in the O & M manual.

All boosted cold water pipework and fittings including valves and flanges shall be thermally insulated.

LTHW HEATING INSTALLATION

The Contractor shall modify the existing LTHW heating installation within the roof level plantroom to provide primary flow and return connections to the new and existing domestic hot water storage cylinders as indicated on the tender drawings.

The modification works shall include cutting back the existing 40mm HWS primary flow and return and extending to provide 25mm HWS primary flow and return connections to each HWS storage cylinder complete with isolation valves, commissioning sets, 3 port diverting valves, double regulating valves and twin lock test points.

On completion the pipework shall be tested, balanced and thermally insulated.

The new pipework installation shall be carried-out in heavy weight mild steel tube with screwed joints as specified.

ABOVE GROUND DRAINAGE INSTALLATION

All waste pipes, anti-siphon pipes and fittings shall be MUPVC, 200 waste system with solvent welded joints except where seal ring joints are required for thermal movement and shall comply in all respects with BSEN 1329 - 1 : 2000/BS5255 : 1989 and bear the BSI kite mark.

All drainage pipework associated with laboratories and wash up rooms shall be installed in chemical resistant CPV-Zurn (CPV Ltd) or Vulcathene Durapipe (or similar approved) pipework and fittings, all joints shall be mechanical type installation shall be carried out by installers approved/certified by specialist drainage supplier.

All waste pipe connections to existing drainage pipe shall be via solvent welded bossed pipe connector fittings where connecting to stacks.

The waste pipework shall be provided with suitable fittings to accommodate thermal expansion and movement within the system all in accordance with the manufacturer's recommendations.

Sanitary appliances routed to stub stacks shall be provided with access for cleaning and maintenance.

All pipework penetrations through fire compartment walls and floors shall be provided with fire sleeves in accordance with the current Building Regulation requirements.

The work shall be inspected and tested during installation for soundness and performance in accordance with BSEN 12056 Code of Practice for Sanitary Pipework.

All pipework shall be correctly bracketed to control thermal movement and expansion joints shall be provided to allow thermal movement to take place at a maximum of 2 meter centres for waste pipes and between fixed points over 1 meter centres.

All waste pipe connections to soil stacks shall be via solvent welded bossed pipe connector fittings.

The work shall be inspected and tested during installation for soundness and performance in accordance with BSEN 12056: 2/BS5572 Code of Practice for Sanitary Pipework.

AUTOMATIC CONTROLS INSTALLATION

The Contractor shall employ the following automatic controls specialist (or similar approved) to design, supply and undertake the necessary automatic controls installation associated with the works.

Automated Systems Ltd.

The controls specialist shall provide new 3 port diverting valves, temperature sensors and thermostats to serve the two unvented hot water storage cylinders.

The controls specialist shall modify the existing controls to accommodate the additional hot water storage cylinder.

In addition the controls specialist shall provide monitoring of the new cold water storage tank (temperature and water level) and cold water booster set (fault condition).

The controls specialist shall carry-out all power and controls wiring.

ELECTRICAL INSTALLATION

The controls specialist shall undertake power and controls wiring including all necessary containment etc.

All work undertaken shall comply with the IET Wiring Regulations (BS 7671: 2018) and all relevant British Standard Specifications, Codes of Practice and European Directives.

The controls specialist shall visit the site during the tender period in order to ascertain the nature of the works required to be incorporated and to establish any restrictions and access arrangements etc., as no claim for want of knowledge in this respect will be accepted by the Client at a later date.

Any clarification items which need to be addressed during the tender period shall be raised with the Project Manager prior to tenders being submitted.

The controls specialist shall supply, install, test and commission all power and control wiring associated with the works together with all wire ways, tray work, cleats/brackets, and local isolators etc., to form complete installations all as indicated on the tender drawings.

The controls specialist shall be responsible for liaising with the Contractor to ensure that all wiring details are received in adequate time to complete all wiring and terminations to suit the contract programme and for verifying the correct locations of all plant and control equipment. The controls specialist shall supply all final connections to fixed equipment via heat resistant flexible cable or via flexible conduits as appropriate.

Final connections to all motors, pumps etc., shall be via a local isolator fixed to the building structure or independently mounted and not mounted on the piece of equipment.

The controls specialist shall be responsible for the following:-

a. Liaising with the Contractor with regard to programme, connection details, co-ordination of components within the works, final location of equipment and testing, commissioning and setting into service.

b. Supply and fixing of all wire ways, wiring local isolators, contactors, timeclocks, etc.,

c. Supply, installation and termination of all power and control wiring.

d. Final fixing of all field equipment external to control panels inclusive of thermostats, controllers and temperature sensors etc.,

e. Supply and installation of appropriately sized MCB's and circuit wiring for all new circuits emanating from existing local distribution boards

f. Testing of wiring, commissioning and checking of all plant for correct operation.

Generally, all power and control wiring shall comprise multi-core steel wire armoured cables and/or single core stranded copper cables in Class 4 conduit and trunking having low smoke and flame spread insulation (zero halogen).

The power and control wiring shall be carried-out in accordance with the details indicated on the tender drawings.

The block wiring diagrams provided at tender stage generally indicate the wiring requirements however the controls wiring requirements and controls details are to be confirmed by the controls specialist employed by the Contractor. The controls specialist shall be required to liaise with all parties as necessary and refer to the specification for details of the required installations.

No work relating to associated power and controls wiring must commence on site before the control specialists wiring diagrams are to hand and which have been confirmed as being approved by the Project Manager.

All conduit and trunking systems shall be Class 4 (galvanised) and trunking utilised shall be compliant with the latest revision of the IET Wiring Regulations i.e., with regard to IP rating. Screened cables shall be supplied and installed where specified and indicated on the tender drawings.

Under the direction of the Contractor the controls specialist shall include for the strip out of existing power and control wiring associated with existing equipment, whilst retaining the existing containment for possible re use. Where the existing containment is unsuitable for the accommodation of the new power and control wiring new containment systems shall be provided.

As part of the works the controls specialist shall be responsible for all of the following items:-

- Supply and installation of all power and control cables together with all containment, final isolators etc., associated with the new equipment.

All existing earthing and bonding conductors shall be re-instated and any new earthing and bonding conductors required to ensure compliance with the IET Wiring Regulations (BS7671) shall be supplied and installed by the controls specialist.

BUILDERSWORK

The Contractor shall employ an approved building contractor to undertake all necessary builders work as outlined previously and indicated on the tender drawings.

The Contractor shall provide all necessary builders work information to the building contractor.

All redundant holes resulting from removal of pipework shall be made good including wall finishes.

To accommodate new wash hand basins, existing laboratory furniture shall be cut-back and made good with provision to support new wash hand basins where necessary in the following rooms :-

Portland Wing
- Room 105 : Radiation Lab
- Room 103 : Amfia Lab

The Contractor shall employ a specialist to undertake the modification of laboratory furniture.

The builders work shall be carried out under the direction, control and supervision of the Contractor.

WATER TREATMENT

The Contractor shall employ an approved water treatment specialist to carry out all necessary water treatment works:-

- The Contractor shall include for flushing-out the modified sections of the existing heating system and introduction of additional corrosion inhibitor as necessary on completion.
- The laboratory and domestic hot and cold water services installations shall be flushed out and chlorinated, test certificates shall be included in the O & M manual.

TESTING AND COMMISSIONING

The automatic controls installation shall be tested and commissioned by the controls specialists.

The Contractor shall manage the above works and shall undertake all necessary testing, balancing and commissioning of the new/modified plants.

PERMIT TO WORK SYSTEM

CEH will operate a 'permit to work' system throughout the duration of this contract, no works shall be undertaken unless authorised under the appropriate 'permit to work' issued by CEH, refer to the Pre-Construction Health and Safety Information for permits provided by CEH.

The Contractor shall complete the permit including the provision of all necessary work assessments and method statements to satisfy CEH staff and the Project Manager with regard to the proposed working areas, procedures and special pre-cautions to manage the potential risks/hazards in those areas.

WORKING PROCEDURES AND PROTECTION AGAINST DAMAGE

The Contractor shall provide detailed method statements and risk assessments for the intended works and working procedures which shall be agreed with the Principal Designer, Project Manager and CEH prior to the works commencing.

The Contractor shall provide all necessary protection to the building fabric, flooring, furniture and equipment at all times.

The Contractor shall carefully define the areas of working and take account of all Health and Safety issues to enable the building users to safely proceed with their normal daily activities

Access will be required to all areas of the buildings including plant areas by authorised CEH personnel and their representatives throughout the duration of the works.

The delivery of access equipment and its storage shall be agreed with CEH before delivery to site.

The Contractor shall comply with CEH clearance/handover policy which requires the submission of a completed 'Clearance/Handover Certificate'.

OUT OF HOURS WORKING

Generally work shall be undertaken during normal working hours, the replacement of the existing cold water storage tank involving the draining of tank will require undertaking out of normal hours to avoid disruption to building users, details of which shall be agreed with the Project Manager and CEH staff. It should be noted a small number of building users require 24/7 access.

All works generating excessive noise (as determined by CEH) shall be undertaken out of hours.

The Contractor shall include for all costs associated with the above.

The Contractor shall comply with CEH 'out of normal hours' policy which requires the submission of a completed 'Application for Contractor to work in CEH buildings -Out of Normal Hours'.

OPERATING AND MAINTENANCE MANUAL/AS INSTALLED DRAWINGS

On completion of the works the Contractor is required to provide comprehensive Operating & Maintenance Manuals and 'As Installed' Drawings for each phase of works as previously outlined, these shall include electrical information e.g., electrical test certificates etc.,

LIASON WITH OTHER CONTRACTORS

The Contractor shall note there will be other Contractors undertaking work in the buildings involved during the course of the contract works.

The Contractor shall liaise with these Contractors as necessary with regard to working areas which may affect each party, there may therefore be a requirement to co-ordinate each parties work in particular areas.,

ASBESTOS

The Client has provided all available information on the presence of asbestos within the buildings, prior to commencing the works, refer to the Pre-Construction Health and Safety Information for the Asbestos Management Survey report dated 14th March 2014.

The Contractor shall note his responsibilities with regard to ensuring all operatives on site have the necessary asbestos awareness training.

The Contractor is required to check the Asbestos Management Survey report before working in any of the buildings involved to ensure operatives do not disturb any asbestos containing materials.

The information on the register is provided by Asbestos Building Surveys Ltd, the Contractor should note that where work is required that will disturb the fabric of the building where a management survey has not been intrusive, a refurbishment/demolition survey will be required before work commences.

Where asbestos removal/cleaning works is identified, CEH will place a direct order with the asbestos removal specialist.

WORKING IN OCCUPIED BUILDINGS

All buildings within which work is to be undertaken will be occupied throughout the duration of the works.

It is generally intended that the works be carried-out during normal working hours with the exception of works that will disrupt services to the building users e.g., replacement of cold water storage tank which will require replacement to be undertaken at weekends.

TECHNICAL SCHEDULES

Given the above the Contractor must ensure the building users are able to continue within their normal daily activities, this will require access routes (corridors/stairs etc.,) and fire escape routes to be maintained at all times.

There is a considerable amount of work to be undertaken in main access corridors it will be necessary to carry-out work in a controlled manner, liaising with the building users, working in short sections of corridor and moving along the corridor in a phased manner, further details of the anticipated working methodology are provided in the Pre-Construction Health and Safety Plan.

ACCESS EQUIPMENT

The Contractor shall be responsible for the supply of all necessary access equipment, the type/size/storage etc., shall be determined by site inspection of the works to ensure access is achievable to all necessary internal and external access points relevant to the works.

The Contractor shall ensure the works are undertaken using the appropriate access equipment in accordance with the Health and safety Executives (HSE) Work at Heights Regulations 2005 (WAHR)

DRG. NO.	TITLE	SCALE
Phase 1 Works		
P1493.T/M01	Pentland Wing - Ground Floor Level Hot and Cold Water Services Layout	1:50
P1493.T/M02	1985 Building - Ground Floor Level Hot and Cold Water Services Layout	1:50
P1493.T/M03	1985 Building - Roof Void Level Hot and Cold Water Services Layout	1:50
P1493.T/M04	Site Plan External Services Layout	1:200
P1493.T/M05	Schematic Layout Pentland Wing/1985 Building Hot and Cold water Services	NTS
P1493.T/M06	Schematic Layout Pentland Wing/1985 Building Power and Control Wiring	NTS

PIPEWORK SCHEDULE NO. 1 - LTHW HEATING

Size of Pipe	:	15mm to 50mm
Material/Standard	:	Mild Steel BS 1387 Heavy
Pipeline Standard	:	BSEN 1387 Heavy Black
Site Testing	:	5 Bar
Maximum Working Pressure	:	3 bar
Jointing	:	Screwed with unions to valves and equipment
Isolation Valves	:	Hattersley Ball Valve Fig. 100
Regulation Valves	:	Hattersley DRV Fig. 1432
Commissioning Set	:	Hattersley FODRV Fig 1732
Strainers	:	Hattersley Y-Type Fig 817
Check Valves	:	Hattersley Swing Pattern Fig 47
Drain Cocks	:	Hattersley Fig 371 in exposed places and In exposed places in occupied areas. Hattersley Fig. 81 HU. In services ducts and risers.
Automatic Air Vents	:	Engineering Appliances Spirotop AAV With tamperproof inlet valve.
Brackets	:	Unistrut with Mupro (or similar approved) heavy duty pipe Clamps with liners

Notes

1. Alternative valve manufacturer(s) may be offered for approval.

2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 2 - DOMESTIC HOT WATER SERVICE

Size of Pipe	:	15mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Site Testing	:	7 Bar
Jointing	:	15mm to 54mm Yorkshire non-dezincifiable capillary fittings to BS 864, lead free solder shall be used. Union couplings at all valves and termination connections. 15mm to 54mm Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids
Isolation Valves	:	Hattersley Ballvalve (WRAS approved) Fig 100C.
Ballofix Valves	:	Peglar Yorkshire Straight Pattern 3381ZA (screw driver slot)
Self-Balancing Valves	:	Oventrop Aquastrom VT
Drain Cocks	:	Gunmetal to BS2879 type 'A'
Brackets	:	Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts

Notes

1. Alternative valve manufacturer(s) may be offered for approval.

2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 3 - MAINS AND BOOSTED COLD WATER

Size of Pipe	:	15mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Site Testing	:	7 Bar
Jointing	:	Yorkshire non-dezincifiable capillary fittings to BS 864, Integral lead free solder shall be used. Union couplings at all valves and termination connections 15mm to 54mm Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids
Isolating Valves	:	15mm to 54mm Yorkshire Double Union Stopcock to BS1010 Fig. 508GM and Hattersley Ballvalve (WRAS approved) Fig 100C
Ballofix	:	Pegalar Yorkshire Straight pattern 3381ZA (screwdriver slot) Ballofix type to all draw-off/sanitary appliances 54mm and above Hattersley M541 PN16
Drain Cocks	:	Gunmetal to BS 2879 type 'A' lockshield
Brackets	:	Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts. Maintain continuous vapour barrier

Notes

1. Alternative valve manufacturer(s) may be offered for approval.

2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 4 - TANK COLD WATER SERVICE

Size of Pipe	:	15mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Site Testing	:	7 Bar
Jointing	:	15mm to 54mm Yorkshire non-dezincifiable capillary fittings to BS 864, lead free solder shall be used. Union couplings at all valves and termination connections. 15mm to 54mm Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids
Valves	:	Hattersley Ballvalve (WRAS approved) Fig 100C
Drain Cocks	:	Gunmetal to BS2879 type 'A'
Brackets	:	Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts. Maintain continuous vapour barrier

COLD FEEDS, DRAINS AND DISCHARGES.

Size of Pipe	:	8mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Jointing	:	Yorkshire non-dezincifiable capillary fittings to BS 864, lead free integral solder rings. Only lead free solders shall be used. 15mm to 54mm Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids
Brackets	:	As service they are associated with.

GENERAL

The following insulation schedules shall be read in conjunction with Section 3.00, Standard Technical Specification - Clause 3.9 ' Thermal Insulation', of this Specification.

THERMAL INSULATION SCHEDULE No. 1 LTHW HEATING PIPEWORK

ITEM	**PLANT ROOMS SERVICE RISERS, ROOF VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS**
Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation
Facings	Reinforced aluminium foil
Protection	Sheet metal
Valve and Flange Boxes	Supply and install insulation jackets on all valves, strainers, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 25mm	15mm
32 to 100mm	25mm

THERMAL INSULATION SCHEDULE No.2 **DOMESTIC HOT WATER SERVICE PIPEWORK**

ITEM	**PLANTROOMS, SERVICE RISERS, VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS**
Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation bore coated with factory applied passivating anti corrosive agent
Facings	Reinforced aluminium foil
Protection	Not required
Valve and Flange Boxes	Supply and install insulation jackets (wraps) on all valves, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 22 mm	15mm
28 to 76 mm	25mm
76 to 108 mm	30mm

Notes

1. Include for Kingspan Kooltherm (or similar approved) insulated pipe support inserts.

THERMAL INSULATION SCHEDULE No. 3 **MAINS, TANK AND BOOSTED COLD WATER PIPEWORK**

ITEM	**PLANTROOMS, SERVICE RISERS, ROOF VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS**
Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation bore coated with factory applied passivating anti corrosive agent
Facings	Reinforced aluminium foil
Protection	Not required
Valve and Flange Boxes	Supply and install insulation jackets (wraps) on all valves, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 22 mm	15mm
28 to 54 mm	25mm
67 to 108 mm	30mm

Notes

1. Include for Kingspan Kooltherm (or similar approved) insulated pipe support inserts
2. Include for continuous vapour barrier.

EQUIPMENT SCHEDULE NO. 1 - COLD WATER STORAGE TANK

Manufacturer	:	Flowtech Water Solutions Units 17 & 18 Airfield Approach Business Park Flookburgh Grange-over-Sands Cumbria LA11 7NG
Service	:	Cold Water Storage serving Laboratory System
Quantity	:	One
Type	:	GRP two piece pre-insulated water storage tank complete with inspection covers and raised inlet chamber all complete to Bye-Law 30.
Capacity	:	Nominal - 909 Litres Actual - 710 Litres
Dimensions (external)	:	1308mm x 1030mm x 930mm High (with raised Inlet chamber)
Thermal Insulation	:	50mm thick to top and sides
Connections	:	1No. 25mm MCWS inlet 1No. 50mm TCWS - Outlet 1No. 76mm Insect Screened Overflow 1No. 22mm Screened Overflow/Warning Pipe 1No. 15mm Temp Sensor 1No. 100mm Screened Breather Vent 1No. 35mm Drain Connection
Accessories	:	1No. Vented/Screened Raised Valve Chamber and Inspection Hatch 1No. 500Dia Manhole

Notes

1. Alternative tank manufacturer may be offered for approval

2. Storage tank to be mounted on drip tray, 25mm thick external grade plywood and steelwork stillage

3. Manufacturing drawings indicating size and location of all tank connections are required for approval prior to commencing manufacture.

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EQUIPMENT SCHEDULE NO.2- COLD WATER BOOSTER SET

Manufacturer	:	Flowtech Water Solutions Units 17 & 18 Airfield Approach Business Park Flookburgh Grange-over-Sands Cumbria LA11 7NG
Service	:	Potable Boosted Cold Water to Laboratory System
Quantity	:	One
Type	:	WRAS approved packaged water booster set comprising 2No. Quiet running, multistage high efficiency pumps operating as Duty/ standby each rated at 1.40 Litres/sec, 2900 rpm**,** 0.75 kW motor, units mounted on base frame.
Model	:	Flow boost 2V.E.H.1. 404 inverter driven booster set with 2No. 12 litre flow through anti - cycle vessels
Control System	:	Automatic variable speed pump motor control Sequential pump starting, duty sharing Low water protection Data logging Indication of:- - Pressure - Faults - Power On - Low system pressure - Hours run - Pump failed
System Flow Rate	:	1.40 Litres/sec (90L/min)
Minimum Suction Condition	:	Flooded 1.2m
Working Pressure	:	2.5 Bar
Dimensions (overall)		
Width	:	625 mm
Depth	:	615 mm
Height	:	785 mm (1425mm above vessels)
Connections		
Inlet	:	50 mm Threaded
Outlet	:	40 mm Threaded

Weight	:	TBA kg

Electrical

Supply	:	230V:1Ph: 50Hz (Control Voltage: 24V AC)
Maximum Power Loading	:	150 kW (0.75kW per pump)
FLC	:	7.0 amps (3.5 amps per pump)
Starting	:	Variable Speed

Noise Level : TBA db. (A) At 1

metre

Notes

1. Alternative cold water booster set manufacturer may be offered for approval

2. Unit to be mounted on existing concrete base

2. Unit to be commissioned by manufacturer.

EQUIPMENT SCHEDULE NO. 3 - HWS STORAGE CYLINDER

Service	:	Domestic Hot Water Services - Domestic Areas
Manufacturer	:	Heatrae Sadia Hurricane Way Norwich Norfolk NR6 6EA
Quantity	:	One
Type	:	Megaflow ECO indirect stainless steel storage cylinder
Model	:	210i
Capacity	:	210 Litres
Working Pressure		
Primary	:	1.5 Bar
Secondary	:	0.3 Bar
Max Working Pressure	:	10.0 Bar
Max temperature	:	90^{O}C
Working Temperature	:	60.0^{O}C
Primaries		
Flow Temperature	:	80^{O}C
Return Temperature	:	70^{O}C
Duty	:	23.9kW
Flow Rate	:	0.70 L/s
Connections		
Primary	:	20mm
Primary Return	:	20mm
Secondary Flow	:	20mm
Cold Feed	:	20mm
Electrical		
Supply	:	230V:1Ph: 50Hz
Immersion Heater		
Rating	:	3kW
Dimensions		
Height	:	1486mm
Diameter	:	579mm
Weight	:	45kg (empty)

Notes

1. Alternative HWS storage cylinder manufacturer may be offered for approval

2. Discharge from safety valve tundish outlets to discharge into common drain.

EQUIPMENT SCHEDULE NO. 4 - HWS STORAGE CYLINDER

Service	:	Domestic Hot Water Services -Laboratory System
Manufacturer	:	Heatrae Sadia Hurricane Way Norwich Norfolk NR6 6EA
Quantity	:	One
Type	:	Megaflow ECO indirect stainless steel storage cylinder
Model	:	210i
Capacity	:	210 Litres
Working Pressure		
Primary	:	1.5 Bar?
Secondary	:	0.3 Bar
Max Working Pressure	:	10.0 Bar
Max temperature	:	90^{O}C
Working Temperature	:	60.0^{O}C
Primaries		
Flow Temperature	:	80^{O}C
Return Temperature	:	70^{O}C
Duty	:	23.9kW
Flow Rate	:	0.60 L/s
Connections		
Primary	:	20mm
Primary Return	:	20mm
Secondary Flow	:	20mm
Cold Feed	:	20mm
Electrical		
Supply	:	230V:1Ph: 50Hz
Immersion Heater		
Rating	:	3kW
Dimensions		
Height	:	1486mm
Diameter	:	579mm
Weight	:	45kg (empty)

Notes

1. Alternative HWS storage cylinder manufacturer may be offered for approval

2. Discharge from safety valve tundish outlets to discharge into common drain.

EQUIPMENT SCHEDULE NO. 5- CIRCULATION PUMPS

Manufacturer : Grundfos Pumps Ltd
Service : Hot Water Service Secondary Pumps
Type : In-Line Bronze Circulator (WRAS approved)

REF	SERVICE	MODEL	VOLUME FLOW RATE (L/s)	DEVELOPED PRESSURE (kappa)	MOTOR RATING	FULL LOAD CURRENT (amps)	ELECTRICAL SUPPLY
P1	Domestic System - HWS Return	UPS25-55N	0.40	35	120	0.49	240V : 1Ph : 50Hz
P2	Domestic System - De-stratification	UP20-07N	0.25	5	50	0.24	240V : 1Ph : 50Hz
P3	Laboratory System - HWS Return	UPS25-55N	0.40	35	120	0.49	240V : 1Ph : 50Hz
P4	Laboratory System - De-stratification	UP20-07N	0.25	5	50	0.24	240V : 1Ph : 50Hz

Notes.

1. Alternative pump manufacturer may be offered for approval
2. Pumps to include isolation valves on inlet, isolation and double check valves outlet

EQUIPMENT SCHEDULE NO.6 **WASH HAND BASINS**

Service	:	New wash hand basins within laboratories and wash up rooms
Manufacturer	:	Armitage Shank
Quantity	:	7
Type	:	Armitage Shanks vitreous china Portman 21 500mm wash basin (without overflow) with wall/panel fixing set
Taps	:	Armitage Shanks Markwik pillar mixer tap S8200(AA)
Drainage Installation	:	Include for 32mm x 75 deep seal trap with 32mm connection to existing drainage

Notes

1. Alternative wash hand basin manufacturer may be offered for approval
2. Review each location on site and include for repositioning any wall mounted equipment in the proposed locations.
3. Include for modifying existing laboratory furniture to accommodate wash hand basins.
4. Include for pillar tap on each wash hand basin
5. Include for 32mm waste connection from new wash hand basin to existing drainage installation

EQUIPMENT SCHEDULE NO. 7 - AUTOMATIC CONTROLS INSTALLATION

The Contractor shall include for the works to the automatic controls installation including design, supply and installation be carried out by the following controls specialist (or similar approved):

Automated Systems Ltd.

The work content of the controls specialist under the co-ordination, direction and control of the Contractor shall be generally as follows: -

1. Supply of loose items of controls as scheduled in this specification.

2. Supply of all controllers and hardware to allow full control and monitoring.

3. Supply of all software.

4. Supply of the control panels as scheduled in this specification.

5. Co-ordination and site supervision.

6. Installation drawings, comprehensive wiring diagrams, as-installed drawings and maintenance manuals.

7. Full system test, commissioning and demonstration.

The Contractor shall include in his tender for modifying the existing control panel and installing all loose items of control including control valves, detectors, thermostats, pressure switches, etc., as detailed in the schedules.

All power and control electrical wiring shall be carried out by the Controls Specialist

Control Panel

The Phase 1 mechanical services installation shall be controlled and monitored from the existing control panel located in the roof level plantroom:

The control panel shall be fitted with a Niagara based BMS controller and associated I/O modules to provide control and functionality as set out below.

Plant Control & Monitoring

Plant time and temperature control, biased towards energy conservation and efficiency, shall be provided by a Niagara based DDC controller mounted within the control panel.

The panel shall be complete with a facial display that shall afford local configuration of plant time programs and temperature set-points.

Configured graphic pages shall be engineered within the controller and subject to the necessary IT infrastructure being in place shall be available to view via any web browser.

Description of Operation.

Control Panel

General

The existing control panel shall be modified to serve the following items of mechanical services plant

2No. Hot water service storage cylinders
2No. HWS de-stratification pumps
2No. HWS secondary pumps.
1No. Cold water booster set
1No. Cold water storage tank

Hot Water Services

Constant temperature hot water shall feed the indirect heating coils of the HWS storage cylinders serving the following:-

- HWS storage cylinder - Domestic System
- HWS storage cylinder - Laboratory System

The HWS storage cylinders shall be directly controlled via the DDC controller, maintaining a stored water temperature of 60°C (adjustable) by the opening and closing of the associated HWS primary 3-port control valve.

A manual reset high limit thermostat fitted in the storage cylinders secondary flow pipework, set at 75°C shall close a two port zone valve in the HWS primary heating circuit to isolate the LTHW, switch off the HWS secondary and destratification pumps and over-ride the HWS storage cylinders 3-port valve to the by-pass position. The high limit thermostat shall require manually resetting in the event of activation. A lamp shall illuminate on the control panel fascia to indicate this and a critical alarm raised with the BMS.

Each HWS storage cylinder shall be provided with a de-stratification pump which shall run continuously during HWS demand periods.

The common HWS secondary flow and return temperatures shall be monitored by the BMS.

Hot water service (HWS) secondary pump.

A single HWS secondary circulating pump shall be provided serving each HWS storage cylinder.

The pump shall be enabled by the following:

- Hot water services time program.

Individual hand/off/auto switches shall be provided.

Run and trip indication shall be provided on the control panel.

Standby HWS immersion heater

An immersion heater shall be provided for emergency standby use in each storage cylinder.

The immersion heater shall be electrically supplied from a local DB and be complete with integral thermostat.

A cold-water booster set shall be provided to serve the laboratory cold water system. The cold-

water booster set is electrically supplied from a local distribution board.

Electrical interlocks shall be provided between the cold water storage water tank low level switch and cold water booster set preventing operation in low-level alarm conditions. Cold water storage water tank high level shall also be monitored.

In the event of a fault within the cold water booster set, an alarm shall be raised both visually at the control panel and within the BMS.

A temperature sensor installed within the cold water storage tank shall be monitored by the BMS.

Loose control schedule

2 - HWS storage cylinder high limit thermostat.
2 - HWS storage cylinder 3-port control valve (25mm) and actuator.
2 - HWS storage cylinder 2-port control valve (25mm) and spring return actuator. 2 - HWS storage cylinder temperature sensors
2 - HWS secondary flow temperature sensor 2 - HWS secondary return temperature sensor 1 - CWS tank high level switch
1 - CWS tank low level switch
1 - CWS tank temperature sensors

PHASE 2.

The existing LTHW heating installation shall require modification to accommodate two new unvented hot water storage cylinders.

The existing automatic controls installation shall be modified to control and monitor the new domestic hot water storage cylinders.

The works shall include all associated power and control wiring.

The works shall also include all associated builders work.

The Contractor shall undertake the work as Principal Contractor and will be required to comply with the duties this involves under CDM regulations.

The work will generally be carried-out during normal working hours in occupied buildings and will require careful consideration to the working methodology to ensure the building users are able to continue with their normal daily activities in a safe working environment.

Any interruption of services, disconnection and modification of systems etc., shall only be carried-out following discussion and agreement with the Project manager and building users.

The Contractor shall ensure that all services are co-ordinated on site to avoid clashes with the building structural elements and existing/new engineering services.

The Contractor shall visit site during the tender period to ascertain the nature of any restrictions which may affect his tender as no claim for want or lack of knowledge in this respect will be considered by the Client at a later date.

The Contractor shall include within his tender for the provision of 'As-Fitted' drawings and Operating and Maintenance manuals.

The Contractor shall provide 2No. Paper prints of the 'As-Fitted' drawings.

The drawings shall also be submitted on compact disc using the current version of AutoCAD. The 'As-Fitted' drawings shall comprise the installation drawings and specification schedules fully updated to reflect the final installation.

Two copies of the Operating and Maintenance manual shall be provided, the manuals shall be A4 size and bound in a stiff backed binders. The format shall be in accordance with the BSRIA Application Guide January 1987 - 'Operating and Maintenance Manuals for Building Services'.

Draft copies of the 'As-Fitted' Drawings and Operating and Maintenance manuals shall be submitted for approval. A minimum of two working weeks shall be allowed for checking and approval.

It should be noted that the provision of 'As-Fitted' Drawings and Operating and Maintenance Manual is a requirement to be fulfilled before the completed installations can be accepted for handover and the works deemed to be Practically Complete.

Copies of the 'As-Fitted' Drawings and Operating and Maintenance Manual will be required to be included in the Health and Safety File and the document must be complete in order to achieve Practical completion.

The Contractor shall note that the works shall be carried out in accordance with the Construction, Design and Management (CDM) Regulations 2015, therefore all necessary method statements and risk assessments shall be produced and submitted for comment prior to commencement on site.

The Contractor shall note the works shall be carried-out in accordance with Approved Document L2 of the Building Regulations. The Contractor shall provide relevant information for the Building Log Book for the works executed in accordance with the requirements of L2.

The relevant information for the Building Log Book shall comply with CIBSE publications TM31 and be based on the CIBSE Building Log Book template.

The relevant information for the Building Log Book shall be submitted for approval and shall be available to the Client at handover.

STRIP-OUT WORKS

The Contractor shall include for dismantling and removal from site of all obsolete mechanical and electrical engineering services.

The works shall involve but not be limited to the strip out of the following:-

- hot water service storage cylinder
- electric water heaters and associated pipework and wiring
- pipework (associated materials), valves, fittings, supports, insulation etc.,

The full extent of the strip-out works shall be determined by site inspection

INCOMING MAINS COLD WATER SERVICE

The existing mains cold water service enters the remote tank room to serve a cold water storage tank as indicated on the tender drawings.

The existing mains cold water shall be modified as follows:-

- replace all mains cold water pipework from the existing meter located in the ground floor battery charging room
- Provide a new mains cold water service within the tank room with connections to 2No. new cold water storage tanks

The mains cold water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

All pipework and fittings shall be flushed-out and chlorinated on completion of the works, the water specialist shall provide certificates for inclusion in the O & M manual.

All mains cold water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED HOT WATER SERVICES - DOMESTIC SYSTEM

A new unvented hot water storage cylinder shall be installed in the ground floor plantroom (Room 59) of the 1974 Building to provide domestic hot water to the following :-

- wash hand basins in laboratories
- wash hand basins in toilet areas
- sinks in kitchen/brew areas
- showers in toilet area
- cleaners sinks

The new storage cylinder shall be supplied with boosted cold water complete with unvented kit, a de-stratification pump set shall be installed.

The new domestic hot water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped,

within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - push-fit and compression fittings and flexible connections shall not be used.

New wash hand basins complete with pillar mixing taps shall be installed in the following rooms:-

Cairngorm Wing
- Room 211 : Plant Ecology Lab
- Room 212 : Terrestrial Microscopy

1974 Building
- Room 53 : Sequencing Lab
- Room 57 : Animal Prep
- Room 58 : Soils & Ovens Lab
- Room 63 : Molecular Lab
- Room 65 : Wash-up room
- Room 68 : SEAL Lab

Generally blending valves shall not be installed on wash hand basins (CEH requirement), the only exception shall be the disabled toilet in Room 202.

All domestic hot water outlets shall be fitted with ballofix isolation valves (adjacent WHB taps, sink taps, shower valves etc.).

All pipework and fittings shall be flushed-out and chlorinated on completion of the works, the water specialist shall provide certificates for inclusion in the O & M manual.

All domestic hot water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED HOT WATER SERVICES - LABORATORY SYSTEM

A new unvented hot water storage cylinder shall be installed in the ground floor plantroom (Room 59) of the 1974 Building to provide domestic hot water to the following :-

- sinks in laboratories

The new storage cylinder shall be supplied with boosted cold water and shall include an unvented kit, a de-stratification pump set shall be installed.

The new domestic hot water services installation shall be installed in copper pipework (Table x).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push fit and compression fittings shall not be used.

All laboratory hot water outlets shall be fitted with ballofix isolation valves (adjacent lab taps, dishwashers, autoclaves etc).

All lab taps shall be fitted with Arboles UK Ltd (or similar approved) WRAS approved ant-syphon nozzles.

All pipework and fittings shall be flushed out and chlorinated on completion, the water specialist shall provide certificates for inclusion in the O & M manual.

All laboratory system hot water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED COLD WATER SERVICES - DOMESTIC SYSTEM

A new cold water booster set shall be installed in the remote tank room to serve the following :-

- wash hand basins in laboratories
- wash hand basins in toilet areas
- sinks and dishwashers in brew areas
- sinks in cleaners rooms
- showers in toilet area
- WC's and urinals

Boosted cold water shall be provided to serve the unvented hot water storage cylinder serving the domestic areas.

The new boosted cold water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

New wash hand basins complete with pillar mixing taps shall be installed in the following rooms:-

Cairngorm Wing

- Room 211 : Plant Ecology Lab
- Room 212 : Terrestrial Microscopy

1974 Building

- Room 53 : Sequencing Lab
- Room 57 : Animal Prep
- Room 58 : Soils & Ovens Lab
- Room 63 : Molecular Lab
- Room 65 : Wash-up room
- Room 68 : SEAL Lab

All boosted cold water outlets shall be fitted with ballofix isolation valves (adjacent WHB taps, sink taps, WC's, shower valves etc.).

All new and existing pipework and fittings shall be flushed-out and chlorinated, on completion the water specialist shall provide certification for inclusion in the O & M manual.

All boosted cold water pipework and fittings including valves and flanges shall be thermally insulated.

BOOSTED COLD WATER SERVICES - LABORATORY SYSTEM

The existing cold water booster set located in the remote tank room shall be retained to serve the following:-

- sinks within laboratories
- autoclaves within washrooms
- sinks in washrooms
- ice machine in washroom

The cold water storage tank shall comprise a two piece tank complete with drip tray mounted on a steelwork stillage with plywood base to support the tank.

The cold water booster set shall comprise a packaged dual pump (run-and standby)

arrangement with control panel on a common base.

Boosted cold water shall be provided to serve the unvented hot water storage cylinder serving the laboratories.

The boosted cold water services installation shall be installed in copper pipework (Table X).

To minimise the risk of a fire, all pipework within plantrooms and roof void areas shall be crimped, within occupied areas e.g., laboratories, offices, kitchens, toilets etc., all pipework shall be soldered.

Note - flexible connections, push-fit and compression fittings shall not be used.

All boosted cold water outlets shall be fitted with ballofix isolation valves (adjacent lab taps, fume cupboard taps, dishwashers, autoclaves etc.).

All lab taps shall be fitted with Arboles UK Ltd (or similar approved) WRAS approved ant-syphon nozzles.

All new and existing pipework and fittings shall be flushed-out and chlorinated, on completion the water specialist shall provide certification for inclusion in the O & M manual.

All boosted cold water pipework and fittings including valves and flanges shall be thermally insulated.

LTHW HEATING INSTALLATION

The Contractor shall modify the existing LTHW heating installation within the ground floor plantroom (Room 59) of the 1974 Building to provide primary flow and return connections to the new and existing domestic hot water storage cylinders as indicated on the tender drawings.

The modification works shall include cutting back the existing 40mm HWS primary flow and return and extending to provide 25mm HWS primary flow and return connections to each HWS storage cylinder complete with isolation valves, commissioning sets, 3 port diverting valves, double regulating valves and twin lock test points.

In addition the contractor shall include for the re-positioning of the existing radiator in the Soil & Ovens Lab (Room 58) to facilitate the installation of a new wash hand basin.

On completion the pipework shall be tested, balanced and thermally insulated.

The new pipework installation shall be carried-out in heavy weight mild steel tube with screwed joints as specified.

ABOVE GROUND DRAINAGE INSTALLATION

All waste pipes, anti-siphon pipes and fittings shall be MUPVC, 200 waste system with solvent welded joints except where seal ring joints are required for thermal movement and shall comply in all respects with BSEN 1329 - 1 : 2000/BS5255 : 1989 and bear the BSI kite mark.

All drainage pipework associated with laboratories and wash up rooms shall be installed in chemical resistant CPV-Zurn (CPVLtd) or Vulcathene (Durapipe) (or similar approved) pipework and fittings, all joints shall be mechanical type installation shall be carried out by installers approved/certified by specialist drainage supplier.

All waste pipe connections to existing drainage pipe shall be via solvent welded bossed pipe connector fittings where connecting to stacks.

The waste pipework shall be provided with suitable fittings to accommodate thermal expansion and movement within the system all in accordance with the manufacturer's recommendations.

Sanitary appliances routed to stub stacks shall be provided with access for cleaning and maintenance.

All pipework penetrations through fire compartment walls and floors shall be provided with fire sleeves in accordance with the current Building Regulation requirements.

The work shall be inspected and tested during installation for soundness and performance in accordance with BSEN 12056 Code of Practice for Sanitary Pipework.

All pipework shall be correctly bracketed to control thermal movement and expansion joints shall be provided to allow thermal movement to take place at a maximum of 2 meter centres for waste pipes and between fixed points over 1 meter centres.

All waste pipe connections to soil stacks shall be via solvent welded bossed pipe connector fittings.

The work shall be inspected and tested during installation for soundness and performance in accordance with BSEN 12056: 2/BS5572 Code of Practice for Sanitary Pipework.

AUTOMATIC CONTROLS INSTALLATION

The Contractor shall employ the following automatic controls specialist (or approved alternative) to design, supply and undertake the necessary automatic controls installation associated with the works.

Automated Systems Ltd.

The controls specialist shall provide new 3 port diverting valves, temperature sensors and thermostats to serve the two unvented hot water storage cylinders.

The controls specialist shall modify provide a new control panel adjacent to the HWS storage cylinders to control and monitor the stored water and provide remote indication of temperature or fault conditions

In addition the controls specialist shall provide a new control panel in the remote tank room to monitor the new cold water storage tanks (temperature and water level) and cold water booster sets (fault condition)

The controls specialist shall carry-out all power and controls wiring.

ELECTRICAL INSTALLATION

The controls specialist shall undertake power and controls wiring including all necessary containment etc.

All work undertaken shall comply with the IET Wiring Regulations (BS 7671: 2018) and all relevant British Standard Specifications, Codes of Practice and European Directives.

The controls specialist shall visit the site during the tender period in order to ascertain the nature of the works required to be incorporated and to establish any restrictions and access arrangements etc., as no claim for want of knowledge in this respect will be accepted by the Client at a later date.

Any clarification items which need to be addressed during the tender period shall be raised with the Project manager prior to tenders being submitted.

The controls specialist shall supply, install, test and commission all power and control wiring associated with the works together with all wire ways, tray work, cleats/brackets, and local isolators etc., to form complete installations all as indicated on the tender drawings.

The controls specialist shall be responsible for liaising with the Contractor to ensure that all wiring details are received in adequate time to complete all wiring and terminations to suit the

contract programme and for verifying the correct locations of all plant and control equipment. The controls specialist shall supply all final connections to fixed equipment via heat resistant flexible cable or via flexible conduits as appropriate.

Final connections to all motors, pumps etc., shall be via a local isolator fixed to the building structure or independently mounted and not mounted on the piece of equipment.

The controls specialist shall be responsible for the following:-

a. Liaising with the Contractor with regard to programme, connection details, co-ordination of components within the works, final location of equipment and testing, commissioning and setting into service.

b. Supply and fixing of all wire ways, wiring local isolators, contactors, timeclocks, etc.,

c. Supply, installation and termination of all power and control wiring.

d. Final fixing of all field equipment external to control panels inclusive of thermostats, controllers and temperature sensors etc.,

e. Supply and installation of appropriately sized MCB's and circuit wiring for all new circuits emanating from existing local distribution boards

f. Testing of wiring, commissioning and checking of all plant for correct operation.

Generally, all power and control wiring shall comprise multi-core steel wire armoured cables and/or single core stranded copper cables in Class 4 conduit and trunking having low smoke and flame spread insulation (zero halogen).

The power and control wiring shall be carried-out in accordance with the details indicated on the tender drawings.

The block wiring diagrams provided at tender stage generally indicate the wiring requirements however the controls wiring requirements and controls details are to be confirmed by the controls specialist employed by the Contractor. The controls specialist shall be required to liaise with all parties as necessary and refer to the specification for details of the required installations.

No work relating to associated power and controls wiring must commence on site before the control specialists wiring diagrams are to hand and which have been confirmed as being approved by the Project manager.

All conduit and trunking systems shall be Class 4 (galvanised) and trunking utilised shall be compliant with the latest revision of the IET Wiring Regulations i.e., with regard to IP rating. Screened cables shall be supplied and installed where specified and indicated on the tender drawings.

Under the direction of the Contractor the controls specialist shall include for the strip out of existing power and control wiring associated with existing equipment, whilst retaining the existing containment for possible re use. Where the existing containment is unsuitable for the accommodation of the new power and control wiring new containment systems shall be provided.

As part of the works the controls specialist shall be responsible for all of the following items:-

- Supply and installation of all power and control cables together with all containment, final isolators etc., associated with the new equipment.

All existing earthing and bonding conductors shall be re-instated and any new earthing and bonding conductors required to ensure compliance with the IET Wiring Regulations (BS7671) shall be supplied and installed by the controls specialist.

BUILDERSWORK

The Contractor shall employ an approved building contractor to undertake all necessary builders work as outlined previously and indicated on the tender drawings.

The Contractor shall provide all necessary builders work information to the building contractor.

All redundant holes resulting from removal of pipework shall be made good including wall finishes.

To accommodate new wash hand basins, existing laboratory furniture shall be cut-back and made good with provision to support new wash hand basins where necessary in the following rooms :-

Cairngorm Wing
- Room 211 : Plant Ecology Lab

1974 Building
- Room 53 : Sequencing Lab

The Contractor shall employ a specialist to undertake the modification of laboratory furniture.

The builders work shall be carried out under the direction, control and supervision of the Contractor.

WATER TREATMENT

The Contractor shall employ an approved water treatment specialist to carry out all necessary water treatment works:-

- The Contractor shall include for flushing-out the modified sections of the existing heating system and introduction of additional corrosion inhibitor as necessary on completion.
- The laboratory and domestic hot and cold water services installations shall be flushed out and chlorinated, test certificates shall be included in the O & M manual.

TESTING AND COMMISSIONING

The automatic controls installation shall be tested and commissioned by the controls specialists.

The Contractor shall manage the above works and shall undertake all necessary testing, balancing and commissioning of the new/modified plants.

PERMIT TO WORK SYSTEM

CEH will operate a ‘permit to work’ system throughout the duration of this contract, no works shall be undertaken unless authorised under the appropriate ‘permit to work’ issued by CEH, refer to the Pre-Construction Health and Safety Information for permits provided by CEH.

The Contractor shall complete the permit including the provision of all necessary work assessments and method statements to satisfy CEH staff and the Project manager with regard to the proposed working areas, procedures and special pre-cautions to manage the potential risks/hazards in those areas.

WORKING PROCEDURES AND PROTECTION AGAINST DAMAGE

The Contractor shall provide detailed method statements and risk assessments for the intended works and working procedures which shall be agreed with the Principal Designer, Project manager and CEH prior to the works commencing.

The Contractor shall provide all necessary protection to the building fabric, flooring, furniture and equipment at all times.

The Contractor shall carefully define the areas of working and take account of all Health and Safety issues to enable the building users to safely proceed with their normal daily activities

Access will be required to all areas of the buildings including plant areas by authorised CEH personnel and their representatives throughout the duration of the works.

The delivery of access equipment and its storage shall be agreed with CEH before delivery to site.

The Contractor shall comply with CEH clearance/handover policy which requires the submission of a completed 'Clearance/Handover Certificate'.

OUT OF HOURS WORKING

Generally work shall be undertaken during normal working hours, the replacement of the existing cold water storage tank involving the draining of tank will require undertaking out of normal hours to avoid disruption to building users, details of which shall be agreed with the Project manager and CEH staff. It should be noted a small number of building users require 24/7 access.

All works generating excessive noise (as determined by CEH) shall be undertaken out of hours.

The Contractor shall include for all costs associated with the above.

The Contractor shall comply with CEH 'out of normal hours' policy which requires the submission of a completed 'Application for Contractor to work in CEH buildings -Out of Normal Hours'.

OPERATING AND MAINTENANCE MANUAL/AS INSTALLED DRAWINGS

On completion of the works the Contractor is required to provide comprehensive Operating & Maintenance Manuals and 'As Installed' Drawings for each phase of works as previously outlined, these shall include electrical information e.g., electrical test certificates etc.,

LIASON WITH OTHER CONTRACTORS

The Contractor shall note there will be other Contractors undertaking work in the buildings involved during the course of the contract works.

The Contractor shall liaise with these Contractors as necessary with regard to working areas which may affect each party, there may therefore be a requirement to co-ordinate each parties work in particular areas.,

ASBESTOS

The Client has provided all available information on the presence of asbestos within the buildings, prior to commencing the works, refer to the Pre-Construction Health and Safety Information for the Asbestos Management Survey report dated 14th March 2014.

The Contractor shall note his responsibilities with regard to ensuring all operatives on site have the necessary asbestos awareness training.

The Contractor is required to check the Asbestos Management Survey report before working in any of the buildings involved to ensure operatives do not disturb any asbestos containing materials.

The information on the register is provided by Asbestos Building Surveys Ltd, the Contractor should note that where work is required that will disturb the fabric of the building where a management survey has not been intrusive, a refurbishment/demolition survey will be required before work commences.

Where asbestos removal/cleaning works is identified, CEH will place a direct order with the asbestos removal specialist.

WORKING IN OCCUPIED BUILDINGS

All buildings within which work is to be undertaken will be occupied throughout the duration of the works.

It is generally intended that the works be carried-out during normal working hours with the exception of works that will disrupt services to the building users e.g., replacement of cold water storage tank which will require replacement to be undertaken at weekends.

Given the above the Contractor must ensure the building users are able to continue within their normal daily activities, this will require access routes (corridors/stairs etc.,) and fire escape routes to be maintained at all times.

There is a considerable amount of work to be undertaken in main access corridors it will be necessary to carry-out work in a controlled manner, liaising with the building users, working in short sections of corridor and moving along the corridor in a phased manner, further details of the anticipated working methodology are provided in the Pre-Construction Health and Safety Plan.

ACCESS EQUIPMENT

The Contractor shall be responsible for the supply of all necessary access equipment, the type/size/storage etc., shall be determined by site inspection of the works to ensure access is achievable to all necessary internal and external access points relevant to the works.

The Contractor shall ensure the works are undertaken using the appropriate access equipment in accordance with the Health and safety Executives (HSE) Work at Heights Regulations 2005 (WAHR)

SCHEDULE OF TENDER DRAWINGS

DRG. NO.	TITLE	SCALE
Phase 2 Works		
P1493.T/M07	Cairngorm Wing Hot and Cold Water Services Layout	1:50
P1493.T/M08	1974 Building Hot and Cold Water Services Layout	1:50
P1493.T/M09	Glasshouses/Remote Buildings Hot and Cold Water Services Layout	1:50
P1493.T/M10	Tank Room Layout	1:25
P1493.T/M11	Site Plan External Services Layout	1:200
P1493.T/M12	Schematic Layout Cairngorm Wing/1974 Building Hot and Cold Water Services	NTS
P1493.T/M13	Schematic Layout Cairngorm Wing/1974 Building Power and Control Wiring	NTS

TECHNICAL SCHEDULES

PIPEWORK SCHEDULE NO. 1 - LTHW HEATING

Size of Pipe	:	15mm to 50mm
Material/Standard	:	Mild Steel BS 1387 Heavy
Pipeline Standard	:	BSEN 1387 Heavy Black
Site Testing	:	5 Bar
Maximum Working Pressure	:	3 bar
Jointing	:	Screwed with unions to valves and equipment
Isolation Valves	:	Hattersley Ball Valve Fig. 100
Regulation Valves	:	Hattersley DRV Fig. 1432
Commissioning Set	:	Hattersley FODRV Fig 1732
Strainers Fig 817	:	Hattersley Y-Type
Check Valves	:	Hattersley Swing Pattern Fig 47
Drain Cocks	:	Hattersley Fig 371 in exposed places and In exposed places in occupied areas. Hattersley Fig. 81 HU. In services ducts and risers.
Automatic Air Vents	:	Engineering Appliances Spirotop AAV With tamperproof inlet valve.
Brackets Clamps with liners	:	Unistrut with Mupro (or similar approved) heavy duty pipe

Notes

1. Alternative valve manufacturer(s) may be offered for approval.

2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 2 - DOMESTIC HOT WATER SERVICE

Size of Pipe	:	15mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Site Testing	:	7 Bar
Jointing	:	15mm to 54mm

Yorkshire non-dezincifiable capillary fittings to BS 864, lead free solder shall be used. Union couplings at all valves and termination connections.

15mm to 54mm
Yorkshire Xpress press-fit system (or
Similar approved) within plantrooms and roof voids

Isolation Valves	:	Hattersley Ballvalve (WRAS approved) Fig 100C.
Ballofix Valves (screw driver slot)	:	Peglar Yorkshire Straight Pattern 3381ZA
Self-Balancing Valves	:	Oventrop Aquastrom VT
Drain Cocks	:	Gunmetal to BS2879 type 'A'
Brackets	:	Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts

Notes

1. Alternative valve manufacturer(s) may be offered for approval.
2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 3 - MAINS AND BOOSTED COLD WATER

Size of Pipe : 15mm to 108mm

Material : Copper

Pipeline Standard : BS EN 1057 (Table X)

Site Testing : 7 Bar

Jointing : Yorkshire non-dezincifiable capillary fittings to BS 864, Integral lead free solder shall be used. Union couplings at all valves and termination connections

15mm to 54mm
Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids

Isolating Valves : 15mm to 54mm Yorkshire Double Union Stopcock to BS1010 Fig. 508GM and Hattersley Ballvalve (WRAS approved) Fig 100C

Ballofix : Pegalar Yorkshire Straight pattern 3381ZA (screwdriver slot)

Ballofix type to all draw-off/sanitary appliances 54mm and above Hattersley

M541 PN16

Drain Cocks : Gunmetal to BS 2879 type 'A' lockshield

Brackets : Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts. Maintain continuous vapour barrier

Notes

1. Alternative valve manufacturer(s) may be offered for approval.
2. All pipework shall be painted one coat of red oxide on completion, prior to installation being applied

PIPEWORK SCHEDULE NO. 4 - **TANK COLD WATER SERVICE**

Size of Pipe	:	15mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Site Testing	:	7 Bar
Jointing	:	15mm to 54mm

Yorkshire non-dezincifiable capillary fittings to BS 864, lead free solder shall be used. Union couplings at all valves and termination connections.

15mm to 54mm
Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids

Valves	:	Hattersley Ballvalve (WRAS approved) Fig 100C
Drain Cocks	:	Gunmetal to BS2879 type 'A'
Brackets	:	Unistrut with Mupro pipe clamps (or similar approved) and Kingspan Kooltherm insulated pipe support inserts.

Maintain continuous vapour barrier

PIPEWORK SCHEDULE NO.5 - OVERFLOWS, WARNING PIPES, OPEN VENTS, COLD FEEDS, DRAINS AND DISCHARGES.

Size of Pipe	:	8mm to 108mm
Material	:	Copper
Pipeline Standard	:	BS EN 1057 (Table X)
Jointing	:	Yorkshire non-dezincifiable capillary fittings to BS 864, lead free integral solder rings. Only lead free solders shall be used.

15mm to 54mm

Yorkshire Xpress press-fit system (or similar approved) within plantrooms and roof voids

Brackets	:	As service they are associated with.

THERMAL INSULATION SCHEDULES

THERMAL INSULATION SCHEDULE No. 1 LTHW HEATING PIPEWORK

ITEM PLANT ROOMS SERVICE RISERS, ROOF VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS

Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation
Facings	Reinforced aluminium foil
Protection	Sheet metal
Valve and Flange Boxes	Supply and install insulation jackets on all valves, strainers, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 25mm	15mm
32 to 100mm	25mm

THERMAL INSULATION SCHEDULE No.2 DOMESTIC HOT WATER SERVICE PIPEWORK

ITEM PLANTROOMS, SERVICE RISERS, VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS

Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation bore coated with factory applied passivating anti corrosive agent
Facings	Reinforced aluminium foil
Protection	Not required
Valve and Flange Boxes	Supply and install insulation jackets (wraps) on all valves, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 22 mm	15mm
28 to 76 mm	25mm
76 to 108 mm	30mm

Notes

1. Include for Kingspan Kooltherm (or similar approved) insulated pipe support inserts.

THERMAL INSULATION SCHEDULE No. 3 MAINS, TANK AND BOOSTED COLD WATER PIPEWORK

ITEM PLANTROOMS, SERVICE RISERS, ROOF VOIDS, DUCTS, CEILING SPACES & FLOOR VOIDS

Standard	BS 5422: 2001
Insulant	Kingspan Kooltherm - 35 Kg/m^3 (or similar approved) Rigid phenolic insulation bore coated with factory applied passivating anti corrosive agent
Facings	Reinforced aluminium foil
Protection	Not required
Valve and Flange Boxes	Supply and install insulation jackets (wraps) on all valves, flanged joints etc.
Pipe Diameter	Thickness of Insulation
15 to 22 mm	15mm
28 to 54 mm	25mm
67 to 108 mm	30mm

Notes

1. Include for Kingspan Kooltherm (or similar approved) insulated pipe support inserts
2. Include for continuous vapour barrier.

EQUIPMENT SCHEDULE NO. 1 - COLD WATER STORAGE TANK

Service : Cold Water Storage serving Domestic System

Manufacturer : Flowtech Water Solutions
Units 17 & 18
Airfield Approach Business Park Flookburgh
Grange-over-Sands Cumbria
LA11 7NG
Tel: 08456 123740
Contact: Paul Havard

Quantity : One

Type : GRP two piece pre-insulated water storage tank complete with inspection covers and raised inlet chamber all complete to Bye-Law 30.

Capacity : Nominal - 909 Litres
Actual - 710 Litres

Dimensions (external) : 1308mm x 1030mm x 930mm High (with raised Inlet chamber)

Thermal Insulation : 50mm thick to top and sides

Connections : 1No. 25mm MCWS inlet
1No. 50mm TCWS - Outlet
1No. 76mm Insect Screened Overflow
1No. 22mm Screened Overflow/Warning Pipe 1No. 15mm Temp Sensor
1No. 100mm Screened Breather Vent 1No. 35mm Drain Connection

Accessories : 1No. Vented/Screened Raised Valve Chamber and Inspection Hatch
1No. 500Dia Manhole

Notes

1. Alternative tank manufacturer may be offered for approval
2. Storage tank to be mounted on drip tray, 25mm thick external grade plywood and steelwork stillage
3. Manufacturing drawings indicating size and location of all tank connections are required for approval prior to commencing manufacture.

EQUIPMENT SCHEDULE NO. 2 - COLD WATER STORAGE TANK

Service : Cold Water Storage serving Laboratory System

Manufacturer : Flowtech Water Solutions
Units 17 & 18
Airfield Approach Business Park
Flookburgh
Grange-over-Sands
Cumbria
LA11 7NG

Quantity : One

Type : GRP two piece pre-insulated water storage tank complete with inspection covers and raised inlet chamber all complete to Bye-Law 30.

Capacity : Nominal - 909 Litres
Actual - 710 Litres

Dimensions (external) : 1308mm x 1030mm x 930mm High (with raised Inlet chamber)

Thermal Insulation : 50mm thick to top and sides

Connections : 1No. 25mm MCWS inlet
1No. 50mm TCWS - Outlet
1No. 76mm Insect Screened Overflow
1No. 22mm Screened Overflow/Warning Pipe 1No. 15mm Temp Sensor
1No. 100mm Screened Breather Vent 1No. 35mm Drain Connection

Accessories : 1No. Vented/Screened Raised Valve Chamber and Inspection Hatch
1No. 500Dia Manhole

Notes

1. Alternative tank manufacturer may be offered for approval
2. Storage tank to be mounted on drip tray on 25mm thick external grade plywood and steelwork stillage
3. Manufacturing drawings indicating size and location of all tank connections are required for approval prior to commencing manufacture.

EQUIPMENT SCHEDULE NO.3- **COLD WATER BOOSTER SET**

Manufacturer : Flowtech Water Solutions
Units 17 & 18
Airfield Approach Business Park Flookburgh
Grange-over-Sands Cumbria
LA11 7NG

Service : Potable Boosted Cold Water to Domestic System

Quantity : One

Type : WRAS approved packaged water booster set comprising 2No. Quiet running, multistage high efficiency pumps operating as Duty/ standby each rated at 1.50 Litres/sec, 2900 rpm0.75 kW motor, units mounted on base frame.

Model : Flow boost 2V.E.H.I.404 inverter driven booster set with 2No. 12 litre flow through anti-cycle vessels

Control System : Automatic variable speed pump motor control
Sequential pump starting, duty sharing
Low water protection Data logging Indication of:-

- Pressure
- Faults
- Power On
- Low system pressure
- Hours run
- Pump failed

System Flow Rate : 1.50 Litres/sec (90L/min)

Minimum Suction Condition : Flooded 1.2m

Working Pressure : 2.5 Bar

Dimensions (overall)
Width : 625 mm
Depth : 615 mm
Height : 785 mm (1425mm above vessels)
Connections
Inlet : 50 mm Threaded
Outlet : 40 mm Threaded

Weight	:	TBA kg

Electrical

Supply	:	230V:1Ph: 50Hz (Control Voltage: 24V AC)
Maximum Power Loading	:	1.50kW (0.75kW per pump)
FLC	:	7.0 amps (3.5 amps per pump)
Starting	:	Variable Speed
Noise Level	:	TBA db. (A) At 1

metre

Notes

1. Alternative cold water booster set manufacturer may be offered for approval
2. Unit to be mounted on existing concrete base
2. Unit to be commissioned by manufacturer.

EQUIPMENT SCHEDULE NO.4- **COLD WATER BOOSTER SET**

Manufacturer : Flowtech Water Solutions
Units 17 & 18
Airfield Approach Business Park Flookburgh
Grange-over-Sands Cumbria
LA11 7NG

Service : Potable Boosted Cold Water to Laboratory
System

Quantity : One

Type : WRAS approved packaged water booster set comprising 2No. Quiet running, multistage high efficiency pumps operating as Duty/ standby each rated at 1.45 Litres/sec, 2900rpm, 0.75 kW motor, units mounted on base frame.

Model : Flow boost 2V.E.H.I.404 inverter driven booster set with 2No. 12 litre flow through ant cycle vessels

Control System : Automatic variable speed pump motor control
Sequential pump starting, duty sharing
Low water protection Data logging Indication of:-

- Pressure
- Faults
- Power On
- Low system pressure
- Hours run
- Pump failed

System Flow Rate : 1.45 Litres/sec (90L/min)

Minimum Suction Condition : Flooded 1.2m

Working Pressure : 2.5 Bar

Dimensions (overall)
Width : 625 mm
Depth : 615 mm
Height : 785 mm) (1425mm above vessels)
Connections
Inlet : 50 mm Threaded
Outlet : 40 mm Threaded

Weight	:	TBA kg

Electrical

Supply	:	230V:1Ph: 50Hz (Control Voltage: 24V AC)
Maximum Power Loading	:	1.50 kW (0.75 kW per pump)
FLC	:	7.0 amps (3.5 amps per pump)
Starting	:	Variable Speed
Noise Level	:	TBA db. (A) At 1

metre

Notes

1. Alternative cold water booster set manufacturer may be offered for approval
2. Unit to be mounted on existing concrete base

2. Unit to be commissioned by manufacturer.

EQUIPMENT SCHEDULE NO. 5 - HWS STORAGE CYLINDER

Service System	:	Domestic Hot Water Services - Domestic
Manufacturer	:	Heatrae Sadia
Hurricane Way Norwich Norfolk NR6 6EA		
Quantity	:	One
Type storage cylinder	:	Megaflow ECO indirect stainless steel
Model	:	210i
Capacity	:	210 Litres
Working Pressure		
Primary	:	1.5 Bar
Secondary	:	0.3 Bar
Max Working Pressure	:	10.0 Bar
Max temperature	:	90^{o}C
Working Temperature	:	60.0^{o}C
Primaries		
Flow Temperature	:	80^{o}C
Return Temperature	:	70^{o}C
Duty	:	23.9kW
Flow Rate	:	0.70 L/s
Connections		
Primary	:	20mm
Primary Return	:	20mm
Secondary Flow	:	20mm
Cold Feed	:	20mm
Electrical		
Supply	:	230V:1Ph: 50Hz
Immersion Heater		
Rating	:	3kW
Dimensions		
Height	:	1486mm
Diameter	:	579mm
Weight	:	45kg (empty)

Notes

1. Alternative HWS storage cylinder manufacturer may be offered for approval
2. Discharge from safety valve tundish outlets to discharge into common drain.

EQUIPMENT SCHEDULE NO. 6 - HWS STORAGE CYLINDER

Service System	:	Domestic Hot Water Services -Laboratory
Manufacturer	:	Heatrae Sadia
Hurricane Way Norwich Norfolk NR6 6EA		
Quantity	:	One
Type storage cylinder	:	Megaflow ECO indirect stainless steel
Model	:	210i
Capacity	:	210 Litres
Working Pressure		
Primary	:	1.5 Bar
Secondary	:	0.3 Bar
Max Working Pressure	:	10.0 Bar
Max temperature	:	90^{o}C
Working Temperature	:	60.0^{o}C
Primaries		
Flow Temperature	:	80^{o}C
Return Temperature	:	70^{o}C
Duty	:	23.9kW
Flow Rate	:	0.55 L/s
Connections		
Primary	:	20mm
Primary Return	:	20mm
Secondary Flow	:	20mm
Cold Feed	:	20mm
Electrical		
Supply	:	230V:1Ph: 50Hz
Immersion Heater		
Rating	:	3kW
Dimensions		
Height	:	1486mm
Diameter	:	579mm
Weight	:	45kg (empty)

Notes

1. Alternative HWS storage cylinder manufacturer may be offered for approval
2. Discharge from safety valve tundish outlets to discharge into common drain.

EQUIPMENT SCHEDULE NO. 7- CIRCULATION PUMPS

Manufacturer : Grundfos Pumps Ltd
Service : Hot Water Service Secondary Pumps
Type : In-Line Bronze Circulator (WRAS approved)

REF	SERVICE	MODEL	VOLUME FLOW RATE (L/s)	DEVELOPED PRESSURE (kappa)	MOTOR RATING (Watts)	FULL LOAD CURRENT (amps)	ELECTRICAL SUPPLY
P1	Domestic System - HWS Return	UPS25-55N	0.40	35	120	0.49	240V : 1Ph : 50Hz
P2	Domestic System - De-stratification	UP20-07N	0.25	5	50	0.24	240V : 1Ph : 50Hz
P3	Laboratory System - HWS Return	UPS25-55N	0.40	35	120	0.49	240V : 1Ph : 50Hz
P4	Laboratory System - De-stratification	UP20-07N	0.25	5	50	0.24	240V : 1Ph : 50Hz

Notes.

1. Alternative pump manufacturer may be offered for approval
2. Pumps to include isolation valves on inlet, isolation and double check valves outlet

EQUIPMENT SCHEDULE NO.8 **WASH HAND BASINS**

Service and wash up rooms	:	New wash hand basins within laboratories
Manufacturer	:	Armitage Shank
Quantity	:	8
Type	:	Armitage Shanks vitreous china Portman 21 500mm wash basin (without overflow) with wall/panel fixing set
Taps S8200 (AA)	:	Armitage Shanks Markwik pillar mixer tap
Drainage Installation 32mm connection to existing drainage	:	Include for 32mm x 75 deep seal trap with

Notes

1. Alternative wash hand basin manufacturer may be offered for approval
2. Review each location on site and include for repositioning any wall mounted equipment in the proposed locations.
3. Include for modifying existing laboratory furniture to accommodate wash hand basins.
4. Include for pillar tap on each wash hand basin
5. Include for 32mm waste connection from new wash hand basin to existing drainage installation

AUTOMATIC CONTROLS INSTALLATION

The Contractor shall include for the works to the automatic controls installation including design, supply and installation be carried out by the following controls specialist (or similar approved):

Automated Systems Ltd.

The work content of the Specialist Controls Contractor under the co-ordination, direction and control of the Mechanical Sub Contractor shall be generally as follows: -

1. Supply of loose items of controls as scheduled in this Specification.

2. Supply of all controllers and hardware to allow full control and monitoring.

3. Supply of all software.

4. Supply of the control panels as scheduled in this Specification.

5. Co-ordination and site supervision.

6. Installation drawings, comprehensive wiring diagrams, as-installed drawings and maintenance manuals.

7. Full system test, commissioning and demonstration.

The Mechanical Sub-Contractor shall include in his tender for installing the control panel and all loose items of control including control valves, detectors, thermostats, pressure switches, etc., as detailed in the schedules.

All power and control electrical wiring shall be carried out by the Automatic Controls Specialist

Control Panel

The Phase 2 mechanical services installation shall be controlled and monitored from the control panel located in the remote boiler plantroom:

Control Panel General Specification.

The control panels shall be Form 1 (single section) supplied pre-wired, complete with the following features as appropriate:

- Door interlocked isolator.
- Panel live lamp.
- MCBs and switch gear to provide all power supply requirements for the plant served from each panel.
- Facia mounted hand / off / auto switches for the main plant items served.
- Status indication lamps for plant served.

- Fire alarm interlock.
- Top entry terminal rail to afford connection of all field wiring.
- LED status indication lamps.
- Engraved trifoliate labels.
- Internally wired in PVC colour coded cable, each cable individually numbered with cable ferrules to a crimped terminal.

Plant Control & Monitoring

Plant time and temperature control, biased towards energy conservation and efficiency, shall be provided by a Niagara based DDC controllers mounted within the control panels.

The panels shall be complete with a facia display that shall afford local configuration of plant time programs and temperature set-points.

Configured graphic pages shall be engineered within the controller and subject to the necessary IT infrastructure being in place shall be available to view via any web browser.

Description of Operation

Control Panels

General

Two new control panels shall serve the following:

- Remote tank room
- Ground floor plantroom (Room 59) 1974 Building

Ground Floor Plantroom, 1974 Building

1No. Variable temperature heating circuit, comprising a twin pump set (future provision)
1No. HWS primary heating circuit, comprising a twin pump set (future provision)
2No. Hot water services storage cylinders 2No.
HWS de-stratification pumps
2No. HWS secondary pumps.

Variable Temperature (VT) Heating

A twin VT heating pump set will be installed at a later date, the following provisions shall be made in the design and supply of the new control panel. The pumps shall be enabled on a demand for heat basis by any of the following:

- VT heating optimiser
- Frost protection

The pumps shall operate on a duty / standby basis via the BMS control system

A water differential pressure switch shall be fitted across the pump set. During programmed operation, if the switch detects a flow failure condition of the duty pump the standby pump shall be automatically brought into operation via the control system.

Indication of a water flow failure condition shall be provided at the control panel.

A critical alarm shall be raised within the BMS in the event of standby pump failure

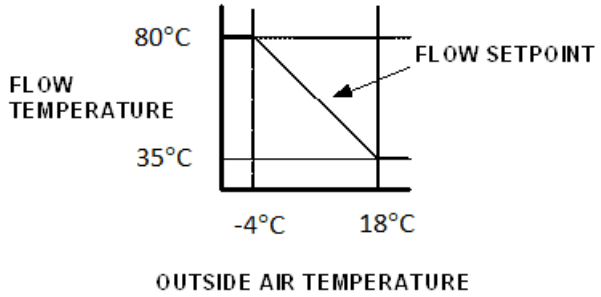
The control system shall provide automatic duty sharing of the lead pump on hours run basis to ensure parity of use of the pumps.

Individual pump 'hand/off/auto' switches and run/trip lamps shall be provided on the control panel.

Heat dissipation timers are provided to maintain pump operation for an adjustable time after the end of occupancy, or demand, to dissipate residual heat within the circuit. During this period the 3-port valve will fully open providing the primary heating circuit has shut down, otherwise the valve will drive to the full bypass position.

Variable Temperature Heating Control

The control of the heating flow temperature shall commence when the duty VT pump is enabled, unless the plant is running in outside air frost protection mode.
The 3-Port modulating valve shall be controlled to provide a variable flow temperature, in accordance with the following schedule: -
Outside Air -4□C - Flow Temperature 80□C
Outside Air 18□C - Flow Temperature
35□C



The VT control temperature set points shall be fully adjustable through the BMS.
The control valve shall be over-ridden closed when the VT pump is off.

VT flow and return temperatures are monitored by the DDC Controller via temperature sensors installed within the heating pipework for control and frost protection purposes.

Space temperature monitoring, a single space temperature sensor shall be provided for heating optimiser and frost protection purposes.

Hot Water Primary (CT) Heating

A twin HWS CT heating pump set will be installed at a later date, the following provisions shall be made in the design and supply of the new control panel. The pumps shall be enabled on a demand for heat basis by any of the following:

- Hot water services
- Frost protection

A water differential pressure switch shall be fitted across the pump set and monitored by the BMS.

Indication of a water flow failure condition shall be provided at the control panel. A

critical alarm shall be raised within the BMS in the event of pump failure

The control system shall provide automatic duty sharing of the lead pump on hours run basis to ensure parity of use of the pumps.

Individual pump 'hand/off/auto' switches and run/trip lamps shall be provided on the control panel.

Hot Water Services

Constant temperature hot water shall feed the indirect heating coils of the HWS calorifiers serving the:

- HWS storage cylinder - Domestic System
- HWS storage cylinder - Laboratory System

The HWS storage cylinder shall be directly controlled via the DDC controller, maintaining a stored water temperature of 60°C (adjustable) by the opening and closing of the associated HWS primary 3-port control valve.

A manual reset high limit thermostat fitted in the storage cylinder secondary flow pipework, set at 75°C shall close a two port zone valve in the HWS primary heating circuit to isolate the LTHW, switch off the HWS secondary and destratification pumps and over-ride the HWS storage cylinder 3-port valve to the by-pass position. The high limit thermostat shall require manually resetting in the event of activation. A lamp shall illuminate on the control panel fascia to indicate this and a critical alarm raised with the BMS.

Each storage cylinder shall be provided with a de-stratification pump which shall run continuously during HWS demand periods.

The common HWS secondary flow and return temperatures shall be monitored by the BMS.

Hot water service (HWS) secondary pump.

A single HWS secondary circulating pump shall be provided serving each storage cylinder

the pump shall be enabled by the following:

- Hot water services time program.

Individual hand/off/auto switches shall be provided.

Run and trip indication shall be provided on the control panel.

Standby HWS immersion heater

An immersion heater shall be provided for emergency standby use in each storage cylinder.

The immersion shall be electrically supplied from a local DB and be complete with integral thermostat.

Remote Tank Room

2No. cold water booster sets
2No. Cold water storage tanks

Packaged cold water booster sets

Two cold-water booster sets shall be provided to serve each cold water system i.e., domestic system and laboratory system.

Each cold water booster set shall be electrically supplied from a local distribution board.

Electrical interlocks shall be provided between the respective cold water storage water tank low level switch and its associated cold water storage booster preventing operation low-level alarm conditions. Cold water storage water tank high level shall also be monitored within each tank.

In the event of a fault with either of the cold water booster sets, an alarm shall be raised both visually at the control panel and within the BMS.

A temperature sensor installed within each cold water storage tank shall be monitored by the BMS.

Loose Control Schedule

1 - Outside air temperature sensor (future provision). 1 - Space temperature sensors (future provision)
2 - Water ΔP switches (future provision)
1 - Variable temperature control valve (future provision).
1 - Variable temperature flow temperature sensor (future provision). 1 - Constant temperature flow temperature sensor (future provision) 2 - HWS storage cylinder high limit thermostat.
2 - HWS storage cylinder 3-port control valve (25mm) and actuator.
2 - HWS storage cylinder 2-port control valve 25mm) and spring return actuator. 2 - HWS storage cylinder temperature sensors
2 - HWS secondary flow temperature sensor 2 - HWS secondary return temperature sensor 2 - CWS tank high level switch
2 - CWS tank low level switch
2 - CWS tank temperature sensor