

MULTI-TERTIARY EDUCATION BUILDING AT DIFE, THE TWENTIES, DROGHEDA, CO. LOUTH

Volume A.2.3

Mechanical Specification

Part 1 of 4: Project Particulars

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Contents

1	GENERAL INFORMATION.....	2
2	OVERVIEW OF MECHANICAL WORKS.....	4
3	M&E COORDINATOR ROLE AND RESPONSIBILITIES.....	23
4	REMOVALS (50).....	29
5	(51) HEATING CENTRE INSTALLATION.....	30
6	(52) SOILS & WASTES INSTALLATION.....	40
7	(53) PLUMBING INSTALLATION.....	43
8	(54) NATURAL GAS INSTALLATION.....	52
9	(56) SPACE HEATING.....	56
10	(57) VENTILATION INSTALLATION.....	63
11	(57) VRF AIR CONDITIONING SYSTEM.....	71
12	(57) COMPRESSED AIR INSTALLATION.....	75
13	(57) VACUUM DELIVERY SYSTEMS.....	77
14	(58) BUILDING ENERGY MANAGEMENT SYSTEM.....	78
15	(67) FIRE PROTECTION SERVICES.....	93
16	COMMISSIONING APPENDIX.....	94

1 GENERAL INFORMATION

1.1 NOTE ON MECHANICAL SPECIFICATION STRUCTURE

Mechanical Specification Part 1: Project Particulars contains information specific to this project and shall be read in conjunction with the design drawings and other parts of the specification i.e., Parts 2 - 4 included. For details on the required specific equipment technical specification, refer to Part 4: Equipment Schedules and also Part 1: Project Particulars and the design drawings. Where an item of equipment is not specified within Part 1, Part 4 nor specified/indicated on the drawings, the materials specification described for those equipment elements in Part 3: Standard Clauses shall apply. The equipment schedules also reference Part 3: Standard Clauses for certain materials and in general, Part 3 clauses shall apply for any item not specified elsewhere. Part 3 workmanship clauses shall apply throughout, unless stated or specified otherwise in Part 1 or on the design drawings.

In the event that an apparent contradiction exists between any of the specification parts or between any of the specification parts and the drawings, this shall be addressed in writing to the Employer's Representative during the tender period for clarification. If an apparent contradiction is not identified during the tender process, then it shall be at the discretion of the Employer's Representative to identify which document or clause takes precedence. Claims raised post-tender in relation to apparent contradictions shall not be entertained and the onus shall remain with the contractor to highlight any such issues during the tendering period. This in no way over-rides the order of precedence of information as defined within the Contract.

1.2 SITE LOCATION

The project is an extension to the existing Institute of Further Education located in The Twenties, Drogheda, Co. Louth.



1.3 DESCRIPTION OF THE SITE

The existing school is a single storey building of circa 5,000m², which was opened in 2004. An extension was added to the school in 2010 with a further extension added in 2012. There is also a number of stand-alone buildings located within the school grounds.

A new extension, approximately 1700 m² to the Drogheda Institute of Further Education (DIFE) is being developed to support the delivery of innovative training programmes and the enhancement of skills in a modern, adaptable learning environment.

This project involves the construction of a two-storey, multipurpose tertiary education building located to the northeast of the existing DIFE campus. The facility will include multi-purpose spaces, specialised teaching and practical rooms, social and collaborative areas and ancillary support facilities. Additionally, new changing rooms will be constructed adjacent to the previously developed all-weather sports pitches, enhancing the overall student experience.

The development also encompasses all associated site works, including utility connections, services, and the provision of car and bicycle parking to support accessibility and sustainability.

1.4 MECHANICAL DRAWING SCHEDULE

Please refer to the Document Issue Schedule

1.5 MECHANICAL WORKS

This document has been prepared using the Common Arrangement of Sections and this Mechanical Works Specification comprises the following:

- NBE 50: Removals
- NBE 51: Heating Centre Installation
- NBE 52: Sanitaryware, Soils & Wastes Installations
- NBE 53: Plumbing Installation
- NBE 54: Gas Installation
- NBE 56: Space Heating Installation
- NBE 57: Mechanical Ventilation Installations
- NBE 58: Building Energy Management System Installation
- NBE 67: Fire Systems

2 OVERVIEW OF MECHANICAL WORKS

2.1 GENERAL

This project is concerned with the proposed extension works and strip out, refurbishment and upgrade of the existing plantroom at *Drogheda Institute of Further Education, The Twenties, Drogheda, Co. Louth*. The Contractor shall include for the supply, delivery, installation, testing, commissioning and setting to work all necessary materials and equipment to carry out the complete mechanical services installation described in the mechanical and electrical tender documents.

New Mechanical building services shall be provided as noted in section 1.4 above and described in detail hereafter within this specification. This specification calls for the supply, delivery, installation, testing, commissioning and setting to work all necessary materials and equipment to carry out the complete mechanical services installation. Each service, when complete, shall be fully tested and commissioned in full accordance with the relevant sections of the specification.

The contractor shall be aware that a number of items relating to BCAR SI9 will be required during the construction phase and prior to practical completion in order for the design team to issue certification and allow practical completion to be achieved. The mechanical contractor shall refer to specific sections of the specifications for further details.

The schedules and drawings accompanying this specification whilst indicating the extent of the works do not purport to be Bills of Quantities and do not include such items as fixings, accessories etc, which shall be supplied together with all other items, whether specifically mentioned in the text or not, necessary to complete the installation in every respect.

Any difference between, or omission from, the said drawings and specification shall not absolve the contractor from liability to provide a complete installation according to the true meaning and intent of all taken together. The contractor shall supply and erect everything implied therein requisite to the satisfactory completion and convenient working of the installation.

Each service, when complete, shall be tested and commissioned in full accordance with the relevant sections of the specification.

This specification shall be read in conjunction with the Conditions of Contract and Contract Preliminaries.

Contractors should note that this is a FIXED PRICE TENDER. This specification shall be read in conjunction with the accompanying drawings and schedules.

2.2 SCOPE OF CONTRACT WORKS

2.2.1 Overall Contract

This project works comprise of a new 2-storey extension building and upgrade to the Plantroom for the existing school.

The mechanical contractor shall refer to the main contract preliminaries for information including programme dates.

2.2.2 Mechanical Works

A brief outline of the proposed Mechanical works requirements include but not limited to the following:

Removals (50)

- Removal of existing boilers, DHW water heater, flues, calorifiers, pipework, pumps, valves and controls from existing Plantroom.

External Site Services (50)

- Installation of New External Low Carbon Heating plant in the form of Commercial Air Source Heat Pump to provide low temperature hot water for heating to the new extension.
- Installation of New External Low Carbon Heating plant in the form of Commercial Air Source Heat Pumps to provide high temperature hot water for heating to the existing school.
- Supply and Installation of Pre-Insulated heating pipework between the external plant compounds and the internal Plantrooms. Pipework shall be installed within formed trench provided by the main contractor.
- Supply and Installation of Pre-Insulated heating pipework between the existing Plantroom and 2012 extension. Pipework shall be installed within formed trench provided by the main contractor.

Heating Centres (51)

- Installation of new Air Source Heat Pump and associated plant as primary heat source serving new extension
- Installation of new Air Source Heat Pumps and associated plant as primary heat source serving existing school
- New Natural Gas supply to central LPHW Heating & Domestic Hot Water plant in new extension Plantroom
- New Natural Gas supply to central LPHW Heating & Domestic Hot Water plant in existing Plantroom
- New Heating Plantroom gas leak detection systems in new extension Plantroom
- New Heating Plantroom gas leak detection systems in existing Plantroom
- Installation of new Natural Gas Boilers and flues in new extension Plantroom

- Installation of new Natural Gas Boilers and flues in existing Plantroom
- Installation of new Natural Gas fired Water Heater and flue in new extension Plantroom
- Installation of new Natural Gas fired Water Heater and flue in existing Plantroom
- LPHW Buffer Vessels Installation in new extension Plantroom
- LPHW Buffer Vessels Installation in existing Plantroom
- New LPHW heating flow and return headers c/w pumped heating circuits in new extension Plantroom
- New LPHW heating flow and return headers c/w pumped heating circuits in existing Plantroom
- New heating & plumbing distribution systems in new extension Plantroom
- New heating & plumbing distribution systems in existing Plantroom
- New BEMS controls installation in new extension Plantroom
- New BEMS controls installation in existing Plantroom

Sanitaryware, Soils & Wastes (52)

- Installation of the complete above ground soils & wastes installation in all school buildings including refurbished area.
- Installation of sanitaryware specified by Architect

Plumbing (53)

- Modifications to existing mains water supply to the 2010 extension building to supply the new extension and new Water Meter
- Installation of new internal potable Cold Water Storage Tank
- Installation of new Potable Cold Water Booster Set
- Distribution of mains water, cold and domestic hot water and domestic hot water services return to all sanitaryware outlets throughout the new school building including pipework, insulation & valves.

Gas (54)

- Modifications to the existing gas supply to the 2010 extension building to supply the new Plantroom and new Gas Meter
- Internal gas distribution to Boilers & Water Heater
- Plantroom Gas Leak Detection Systems

Space Heating (56)

- Modifications to the existing heating supply to the north East building to supply the existing 2010 extension building.
- New LPHW heating flow and return pumped circuit to all new underfloor heating manifolds.
- Installation of LPHW underfloor heating installation to all new school areas
- Fully Automated temperature control via 2-port control valves/UF wiring centres and extra low voltage ModBus wall mounted adjustable temperature controllers to the BEMS

Mechanical Ventilation (57)

- Demand Control Mechanical Heat Recovery Ventilator units to all Teaching spaces and WC/Shower areas within the new extension with local end user controls
- Installation of local extract ventilation from the DCC / IDF room to the adjacent corridor.
- Installation of passive ventilation to internal rooms & stores.

Building Energy Management System (58)

- Replacement of existing school controls to provide Building & Energy Management System (BEMS) control to existing and extension including connection to remote outstations and front end display accessible via school IT network.
- BEMS control panels to control and monitor all plant and equipment in new and existing Heating Plantrooms and field devices
- BEMS front end display accessible via school IT network
- Network link between the new BEMS panel in the extension and new BEMS panel in the existing Plantroom.
- Programming of Front End energy monitoring pages to capture gas, water and electricity usage to include data logging and storing of data spreadsheets on PC for at least 5 years.

Fire Systems (67)

- Installation of portable hand-held and suspended fire extinguishers and fire blankets.
- Installation of Automatic Dry Pendants in each Plantroom.
- Installation of duct mounted Fire Dampers on any mechanical ductwork that passes through a fire rated compartment.

Builder's Works (70)

- Openings, painting, casing, plinths, etc.

2.2.3 EED, Energy Target and Part L Compliance

In conjunction with the EED Engineer a number of measures to minimise the energy consumed during the normal operation of the building into the overall design development strategy have been considered. An EED assessment was carried out to determine the approach to use of building fabrics and sustainable technologies in order to achieve a BER rating of A2 to part L 2017 NZEB compliance.

2.3 DESIGN CRITERIA:

The criteria listed below apply to all Sections included in the Contract unless specified otherwise:

Department of Education & Skills Technical Guidance Documents

- SDG: 02-03: Post Primary School Design Guide
- SDG 02-04: Primary & Post Primary School Specialist Accommodation for Pupils with Special Educational Needs
- SDG 02-06: Sanitary Facilities
- SDG 02-05-03: Acoustic Performance in New Primary & Post Primary Schools
- TGD003: Mechanical & Electrical Building Services Engineering Guidelines for Post Primary School Buildings
- TGD005: Information and Communication Technology (ICT) Infrastructure Guidelines for Post Primary School Buildings
- TGD020: General Design Guidelines for Schools - Primary & Post-Primary
- TGD031.1: Guidelines on Mains Water Distribution Systems in Post Primary Schools
- TGD033: School Building Projects and Compliance with Part L of the Building Regulations 2017
- Design Note 202001 July 2020: Energy Conservation for Mechanical & Electrical Building Services

Engineering Guidance Documents

- CIBSE Design Guides
- BESA DW 143 & DW 144
- Approved Code of Practice and Guidance L8 – The control of legionella bacteria in water systems
- IS 265: Installation of Gas Service Pipes
- IS 329 – Code of Practice for gas distribution mains
- IS 820: Non-Domestic Gas Installations
- Other design guidance where applicable as noted throughout this specification

Statutory Requirements & Regulations

- European Energy Performance of Buildings Directive – Nearly Zero Energy Building (NZEB) Standards
- All Building Control Regulations 1997-2022, in particular Parts F, J, L & M
- Building Control (Amendment) Regulations 2014
- Construction Product Regulations 2013

- Electricity Regulation Act 1999
- ET101:2008 ETCI National Rules for Electrical Installations & Amendment A1:2011
- Safety, Health & Welfare at Work (General Application) 2007
- Department of Environment, Community & Local Government Fire Safety Codes of Practice
- Waste Management (Amendment) Act 2001
- Institute of Gas Engineers and Managers Utilisation Procedures (IGEM/UP1 Ed2)
- National Guidelines for the Control of Legionellosis in Ireland 2009
- EC European Compatibility Regulations 2007
- Fire Officer Requirements
- Relevant (IS), (EN) & (BS) Standards

N.B. Harmonised European Standards (hENs) shall be applied where available. Where no hEN is applicable, order of preference is for appropriate Irish Standards and then British Standards.

Mechanical Design Criteria

Room	Internal Space Temperature	Minimum Mechanical Extract Ventilation	Max Noise Level
	Min / Max °C	Litres/sec or ACH	dB
Classrooms	18/22	9 l/s per Pupil	35
DCC / IDF Rooms	18/25	10 ACH ⁻¹	50
Internal School Offices	18/22	9 l/s per Person	40
Changing Area	18/22	6 ACH ⁻¹	45
Toilets	18	6 ACH ⁻¹	45
Shower Areas	18/22	6 ACH ⁻¹	45
Circulation Spaces	18/22	-	45

2.4 SPECIFIC STATUTORY REQUIREMENTS

2.4.1 Inspection Plan and Notice for Site Inspections

Inspections shall be carried out during the course of the works to review works in progress. Milestone inspections shall during the installation of underground services and occur at first fix, second fix, third fix and commissioning stages of each phase of the project at which point the contractor shall notify the Consulting Engineer when the services are ready for inspection. A milestone inspection shall apply to the entirety of the relevant building being presented for inspection at the same time i.e., a series of partial inspections shall not be permitted for each particular stage.

The contractor must give the Consulting Engineer a minimum of 5 full working-days' notice for inspections at each milestone/stage of the proposed mechanical works. Prior to notifying the Consulting Engineer that a particular stage will be ready for inspection, the contractor shall inspect the works themselves, carry out their own internal snagging, close out all issues snagged and be satisfied that all elements appropriate to that stage have been completed and carried out in accordance with the specification and drawings and in accordance with the Building Regulations. Confirmation to this effect shall be provided in writing at the time of notification.

If due notice is not provided for an inspection and/or the contractor proceeds to close up services without the required notification to the engineer, the engineer shall be at liberty to request the contractor to reveal services for inspection at the contractor's own expense.

Issues raised by the engineer shall be addressed by the contractor and clear photographic evidence shall be provided to prove that each issue has been addressed. Semple McKillop Ltd. will not issue Ancillary Certification to the Assigned Certifier until the contractor has closed out all issues and has provided the necessary documentation for each phase of the works.

All costs associated with meeting BCAR requirements shall be included at tender stage.

Completed O&M manuals which includes a section detailing any product, material and installation changes that has occurred from tender design via the product approval process. These are required 3 weeks before practical completion or phase handover.

2.4.2 Construction Product Regulations (EU305/2011)

From 1 July 2013, all Construction Products covered by a Harmonised European Standard (hEN) or a European Technical Approval (ETA) are required to carry the CE mark. The CE mark indicates that a product has met the essential requirements of all the appropriate Directives and Regulations. The CPR requires Declaration of Performance documents (DoPs) to be available for all CE marked products.

The contractor must provide Declaration of Performance documents and CE certificates for all items at the time of product submittals.

2.4.3 Contractor Design Elements

The contractor shall refer to the Schedule of Ancillary & Commissioning for elements of the works that shall require design certificates from specialists and sub-specialists where a design element is undertaken by such parties. In such cases, the contractor shall ensure that relevant specialists and sub-specialists have professional indemnity insurance in place prior to their appointment and the contractor shall make all due allowances at tender stage for costs associated with same. Policy details will be required to be included on the relevant Ancillary Certificates as listed in the schedule above.

The Contractor is responsible for undertaking the detailed design activities listed below, **as applicable to your Works**, in addition to those activities normally undertaken through the custom and practice of the industry, all of which shall be subject to the comment of the Consulting Engineer.

Your design obligations include, but are not limited to: -

- Preparation of Fabrication drawings and the Co-ordinated Working Drawings, Installation Drawings, Builder's Work Information, Builder's Work Details and Record drawings.
- Undertaking bracket and support detailed design and the selection of appropriate locations for them taking account of any known restrictions on types or location of fixing.
- Builders work: establish details for trenches, pits, sumps, openings, risers, chases, access routes, ladders, step-overs etc for the accommodation of all mechanical services.
- Providing locations and sizes of services penetrations to the main contractor for fire stopping by others.
- Undertaking the final design and selection of the automatic controls insofar as it is required to meet the full physical and operational requirements of the Specification. Ensuring the full compatibility of the plant and equipment with the specified function. Where there are interfaces (including relays or other devices or modifications to hardware or software), being responsible for their design and the incorporation of them. Carrying out all electrical design activities, as detailed herein, relating to the automatic controls system. Preparing detailed BMS point schedules, wiring schematics, control panel labelling details and equipment schedules.
- Dimensioning of, and final installation details of, the automatic control panels to suit the detailed requirements of the particular agreed manufacturers of controls equipment and the cable entry/exit arrangements such that: -
 - Cable entry is possible in the selected location, and Doors are not fouled by other plant, equipment, services or structural elements, and Safe operating and maintenance clearances are provided in all access positions when installed on site
- Selecting attenuators (in conjunction with preferred Manufacturer) to satisfy the particular and performance requirements of the specification, including spatial allowances shown on the Tender drawings.
- Final Design and Selection flue systems for preferred Gas Boilers/Water Heaters and other equipment to meet the requirements of the equipment manufacturer, the Building Control Authority and the Environmental Health Officer, and ensuring that the flue gas is discharged at the required velocity and altitude.
- Selecting valve, damper and access locations.
- Selecting all anti-vibration mountings to suit the particular application of the mounts.
- Selecting exact locations of instruments, control sensors, detectors and thermostats.

- Final sizing of sections of ductwork between terminal units and diffusers to achieve the specified noise criteria and duct velocities.
- Final detailing and confirmation of the location and sizes of duct connections to external louvres.
- Calculating pump and fan duties to suit the piping and ducting layouts shown on your final Installation Drawings to ensure that the specified capacities are not invalidated by your selection of alternative pipe or duct routes, or items of plant and equipment selected for incorporation into the works
- Selecting the capacity, location and design of electrical conduit, trunking, tray and cable ladder systems
- Selecting, positioning and carrying out final sizing of regulating devices (including pressure independent control valves, regulating valves, balancing valves, flow measuring orifice plates, commissioning sets, balancing dampers, etc.), to achieve the specified function and to suit the characteristics of items served and the final configuration of installed systems, in accordance with the recommendations of the manufacturers of the regulating devices.
- Selecting cable terminations on items of equipment provided by you to suit the cable sizes proposed by other Installers (including the electrical Installer, the automatic control system installer, etc.) or the specified cable sizes, as appropriate.
- Phasing and Programming all temporary works, facilities and provisions required during construction, to meet the requirements of the Specification.
- Calculating system water capacities based on the installation drawings and actual equipment intended for installation, in order to properly determine the required capacity of expansion vessels, expansion cisterns, pressure vessels and thermal inertia [buffer] vessels and carrying out final selection of pressurization units.
- Selecting drain and vent point locations and piping gradients in accordance with the current edition of BSRIA BG 29/2012 *Pre-commission cleaning of pipework systems*.

2.5 BREXIT IMPLICATIONS FOR CE MARKING AND DEPLOYMENT OF PRODUCTS FOR CONTRACTS WITHIN THE EU MEMBER STATES INCLUDING REPUBLIC OF IRELAND

The UK left the EU on the 31st January 2020. The contractor shall be aware of the implications and non-compliance since this date for them or any of their sub specialists to install products which are CE marked under UK notified bodies. Post Brexit, UK notified bodies used for certification of conformity for 'CE' marking proposes have lost their status as EU Notified bodies and are/in the process of being removed from the EU Nando website. In such instances the manufacturer of the product now need to obtain alternatives for certification of conformity for 'CE' marking.

The contractor shall be aware that any product CE marked under a UK notified body post Brexit will no longer be accepted. Any products failing to meet this requirement shall be removed and replaced on the project with EU conforming products. All costs associated with removal and reinstatement shall be the responsibility of the contractor. No claims for costs shall be considered.

2.6 SITE VISIT PRIOR TO TENDER SUBMISSION

Tenderers shall arrange to visit the site to ascertain for themselves the full extent and nature of the works and to familiarise themselves with the general site conditions, to its accessibility, Gas Networks Ireland requirements, and the supply of and conditions affecting labour and of executing the contract generally. It is only during such a visit that the contractor can fully ascertain the extent of mechanical services required. All allowances shall be made accordingly at tender stage. During the site visit, the contractor shall also identify and familiarise themselves with the proposed design. Any design queries shall be raised during the tender period.

Tenderers shall note that no claim in respect of lack of knowledge of prevailing site conditions, builders work or existing services can be considered.

The tender drawings are based on the best information available at the time of preparation and by visiting the school the contractor shall satisfy himself of the exact extent and nature of works involved.

2.7 SITE SET UP

The contractor shall provide a site office and materials storage facilities for their own installations. The office shall be complete with telephone connection, a computer with Auto-Cad and email facilities together with broadband connection for receiving documentation/communication from the design team electronically.

All drawings shall be issued to the contractor by email or on disk in Auto-Cad 2015 format.

2.8 PROGRAMME AND PROGRESSING OF CONTRACT WORKS

All contract dates shall be verified with the Main Contractor.

The mechanical contractor shall work closely with the Main Contractor to help produce a fully detailed programme showing the sequence of site operations. Within one week of acceptance of the tender, the Mechanical Contractor shall be required to produce a fully detailed programme showing the sequence of site operations and their inter relativity, including the time limits within which each operation shall be commenced and completed for the electrical, mechanical & builders works. The programme shall account for all conditions to meet with BCAR SI9 requirements.

2.9 EQUIPMENT

The mechanical works shall be carried out with the best quality plant, equipment, materials and workmanship in the manner specified and shall be installed, connected and left in complete operational order to the Engineer's satisfaction in accordance with the true meaning of the specification and contract drawings taken together.

Any equipment, appliance or material not shown on the drawings, but mentioned in the specification or vice versa, or any minor details or accessories not shown or specified, but necessary for the proper installation and operation of the contract works, shall be delivered, supplied and installed by the contractor, without additional expense to the contract. Detailed drawings showing sections of the building and building details are available from the office of the project architects.

2.10 LOCATION OF EQUIPMENT

The location of equipment shown on the drawings is diagrammatic and the final location, mounting heights, etc., of each item shall be agreed with the Engineer in writing before the commencement of works on site.

2.11 SUPERVISION

The mechanical contractor shall retain the same site foreman with a minimum of 5 years fully qualified experience for the duration of the works. This person shall act as their representative on site and be capable to receive such instructions as are necessary for the execution of your obligations and to attend all site meetings when requested. The nominated person shall be capable of project/contract administration. Site operatives shall not be acceptable in this capacity. The contracts manager shall be required to attend all meetings.

2.12 M&E CO-ORDINATOR

The Main Contractor shall employ a full-time M&E co-ordinator for the duration of the project as detailed in Section 4 of this specification.

2.13 CO-ORDINATED / WORKING DRAWINGS

The main contractors M&E co-ordinator shall be responsible for producing a full set of co-ordinated mechanical and electrical working drawings with the primary purpose of defining that information needed by the tradesmen on site to install the works. Please refer to Specification Part 2: General Responsibilities Clause 165.000 for details of requirements.

These drawings shall be produced in AutoCAD and issued to the Design Team for comment. The mechanical contractor shall provide input into working drawings for the M&E co-ordinator.

The M&E co-ordinator shall keep on site available for reference by the Engineer or other authorised person, a full set of their own Mechanical Services working/installation drawings on which he shall record deviations as the work proceeds.

2.14 BUILDER'S WORK & ATTENDANCES ASSOCIATED WITH THE MECHANICAL INSTALLATION

This shall be as defined in the Main Contract Preliminaries.

Based on the signed off M&E Co-ordinated and respective M&E working drawings the M&E Co-ordinator shall then be fully responsible for providing a full set of full dimensioned Builders Works drawings indicating all chasing and opes required in walls, ceilings, floors slabs etc. The Mechanical Contractor shall feed into this process and provide the M&E co-ordinator with any information required to allow him to complete this role. The main contractor under the terms of the main contract shall carry out all builder's work associated with the mechanical & electrical services installation such as forming opes in walls and floors, cutting or drilling of holes, chases in walls, floors or ceilings, joinery works etc and to make good and fire stop around all opes.

The contractor shall be responsible for the fire stopping internally within all mechanical installations that pass through a fire wall/floor for the correct together with marking out of all attendances and all other cutting to be performed.

The M&E co-ordinator shall be responsible for the "marking off" of all holes, chases, and trenches and for providing proper drawings of any floor ducts or equipment bases which may be required.

The Main Contractor shall be responsible for all grounds to support the installation of M&E services. The mechanical contractor shall be required to provide and erect his own secondary support system suspended from the grounds, steelwork or other structure of the building provided under the main contract. All secondary supports shall be installed in an approved manner.

All secondary support systems shall be fit for their purpose particularly in respect of brackets. The M&E Engineer shall approve the support system arrangement and, in this regard, the mechanical contractor shall submit details of fixings etc for approval before installation work commences.

2.15 PRODUCT & SYSTEMS PROPOSALS

It shall remain the contractor's responsibility to ensure that all products & materials supplied are in accordance with the Mechanical specification Parts 1 - 4 inclusive and drawings. Comments issued by Semple & McKillop on contractor proposals do not in any way absolve the contractor from this responsibility. The risk of non-compliance and the supply of unsuitable products or systems shall remain fully with the contractor until the system or product has been installed, tested, commissioned and successfully demonstrated to the engineer and project architects and only in the absence of any defects, shortcomings or non-compliances will only then be deemed acceptable by Semple & McKillop Ltd.

The tenderer must base his tender on the performance specification herein with any named products as an indication of quality.

The engineer shall consider any products put forward by the tenderer and his decision on whether they meet the specification shall be final.

If a contractor wishes the engineer to consider a product, he must obtain approval in principle from the engineer for that product. Approval in principle will only be given when the contractor has submitted a fully itemised comparison schedule for each proposed product set out clearly against the tender specification together with all necessary supporting relevant technical information to prove evidently that the product being proposed by the contractor meets the required specification and the submission must be made early in the contract period to allow the engineer sufficient time to fully review the submitted data (minimum of ten working days). The contractor shall be responsible for carrying out full comparison evaluations and it shall be his responsibility to ensure that all proposed products comply with the specification prior to submittal. The submission of products that do not meet the specification shall be rejected and the consulting engineer shall be at liberty to charge the contractor an hourly rate for time spent reviewing non-compliant submissions.

The consultant's basis for review of 'equal approved' or 'equivalent' products shall be in respect of material, safety, reliability, fitness for purpose, technical performance / support, warranties / guarantees, compatibility with adjacent construction or spatial/dimensional requirements, availability of compatible accessories, spare parts, dimensional size and, where relevant, appearance aesthetics. Any submitted foreign language documents must be accompanied by certified translations into English.

Technical product approval submission for all products and equipment proposed using the equipment schedule sheets in the mechanical and electrical specification is required 2 weeks prior to the required order date.

Samples required from the contractor:

1. Overall Mechanical and Electrical general classbase completed for approval
2. Technical product submission for review and comments for all products and equipment proposed using the equipment schedule sheets in the mechanical and electrical specification. This is required 2 weeks prior to the required order date.
3. Sample Room adjustable space heating thermostat
4. Sample Diffuser/Grille of each type
5. Sample wall mounted Air Transfer Grille
6. Sample Wall Termination Set
7. Sample Roof Cowl
8. Sample CO2 monitoring panel for each classroom
9. Sample non-metallic mains water system
10. Sample External Bib Tap

2.16 SAMPLE ROOM

For this project a sample mock-up of a full classroom shall be constructed by the main contractor with all M&E outlets, fittings and equipment positioned on walls and ceilings as per the Architects Room Data Sheets. The contractor shall include in their contract for fitting out the sample rooms fully of all mechanical installations. All products used within the sample rooms shall not be re-deployed within the main building. The sample room shall remain in situ for the duration of the project. All costs shall be included in tender.

2.17 SAMPLE M&E SERVICES ARRANGEMENTS ABOVE CORRIDOR CEILINGS

The contractor shall provide a mock-up of the typical M&E main distribution services arrangement above the Corridor ceilings to agree in principal, spacing and future maintenance access requirements with the Client / Design Team before deploying through the remainder of the school building. A mock-up of approximately 5 meters will suffice indicating maintenance access and proposed M&E crossovers and how these will be achieved. All costs shall be included in the tender.

2.18 FIRESTOPPING

Refer to Part 3: Standard Clauses of the specification for details on fire-stopping of services. In addition to the details contained within the standard clauses, the mechanical contractor shall allow within their tender for Fire stopping mock up's of mechanical installations passing through fire walls made up on site for fire engineers & architect comment and review prior to installation commencement. Furthermore, fire stopping detail drawings and fire stopping register shall be submitted for review at the commencement of the project. It is a requirement for this project that every mechanical fire stopping location is photographed together with it being traffoyle labelled and cross referenced on as installed drawings and fire stopping register which shall form part of the O&M safety file.

2.19 CLEANLINESS OF SITE

This site shall at all times be kept free from obstruction and rubbish and all surplus materials and temporary works shall be removed from site as soon as these are no longer required. On completion of each section of the works the section shall be left in a clean and tidy state to the satisfaction of the M&E Engineer. The word "site" shall be the area as defined in the Main Contract Preliminaries.

2.20 INSPECTION BEFORE CONCEALMENT

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

Failure to give due notice (minimum 1 working week) may necessitate the mechanical contractor's uncovering the work and reinstating it at his own expense.

2.21 INSPECTION AND TESTING OF WORKS

Where required, the mechanical contractor shall arrange for the consulting engineer and in some instances lead architect and/or end user to visit the various manufacturer's plant to inspect, witness test and/or approve equipment proposed for this project. In such instances the mechanical contractor and their sub specialist shall be responsible for all costs associated with arranging and facilitating this requirement. A minimum of three weeks' notice shall be given to the consulting engineer ahead of any planned inspection visits.

2.22 WATER, LIGHTING, ELECTRIC POWER AND FUEL

The main contractor shall supply temporary water, lighting, electric power and fuel in accordance with the contract preliminaries. Provide all other water, lighting, electric power and fuel necessary for the installation and completion of the sub-contract works, together with the means of supply, generation, storage, distribution and use, as required.

2.23 ASBESTOS

Products containing Asbestos shall not be used.

2.24 DOCUMENTS REQUIRED THREE WEEKS PRIOR TO SUBSTANTIAL COMPLETION

For each phase of the project, the following mandatory is required as part of this contract from the contractor prior to Semple McKillop Ltd. releasing their Ancillary Certification to the Assigned Certifier. Separate certification shall be required for each phase of the works.

- a) All Ancillary Certificates and Testing & Commissioning Certificates as listed in the Schedule of Ancillary & Commissioning Certificates included as part of the tender package. Note: Ancillary Certificates shall be in the template format developed and agreed to satisfy the requirements of BC(A)R, S.I. No.9 of 2014.
- b) Other certificates and information not mentioned in the Schedule of Ancillary & Commissioning Certificates but referenced elsewhere in the specification or contract drawings.
- c) Accurate As-Installed drawings.
- d) Completed O&M manuals which includes a section detailing any product, material and installation changes that has occurred from tender design via the product submittals process. These are required 3 weeks before substantial completion or phase handover.
- e) Declarations of Performance/Conformance in relation to each product supplied by the contractor. (Please note it is the contractor's responsibility to ensure that all products supplied are in accordance with the Building Regulations.)

The following list of mechanical services commissioning certificates are required for BCAR purposes and must be included as part of the Operation & Maintenance manuals. This list is not exhaustive.

1. Overall confirmation that all mechanical installation are in accordance with construction issue consultant's drawings and specifications and current Building Regulations
2. Air Source Heat Pumps commissioning certificates
3. Heating boilers commissioning certificates
4. Heating pressurisation units commissioning certificates
5. Heating circulating pumps commissioning certificates
6. Heating system pipework pressure test certificates
7. Heating system hydraulic balancing commissioning certificates
8. Heating system inhibitor chemical dosing certificates
9. Domestic hot water generators commissioning certificates
10. Domestic hot water return pumps commissioning certificates
11. Cold water booster sets commissioning certificate
12. Plumbing system pipework pressure test certificate (Mains, Cold & Hot Water)
13. Plumbing systems sterilisation/chlorination certificate (Mains, Cold & Hot Water)
14. Domestic hot water system thermal balancing commissioning certificate
15. Thermostatic mixing valves commissioning certificate / Anti-scald fail safe report
16. Gas pipework pressure test certificates
17. Heating Plantrooms Gas Leak Detection Equipment commissioning certificates
18. Gas Pressure Proving systems commissioning certificates
19. Sign off of Natural Gas installation by Registered Gas Installer (RGI) / Declaration of Conformance
20. MHRV Units commissioning certificates
21. Supply & extract ventilation air balancing flow rates test and commissioning certificates
22. Ventilation ductwork cleaning certificate
23. Fire Dampers Test report Certificate
24. Fire Extinguisher installation in accordance IS291:2015
25. BEMS test and commissioning report

In circumstances where a phased or partial handover is intended, then the contractor shall be responsible for preparation of phased hand over documentation of the above.

2.25 COMMISSIONING AND DEMONSTRATIONS

The contractor shall be required to develop and provide a detailed and extensive commissioning and demonstrations schedule encompassing all systems and system elements.

The contractor's commissioning schedule shall also monitor the contractor's internal snagging status for each system. No snagging shall be carried out by the Design Team until the contractor has confirmed in writing they have carried out same and rectified all issues, faults etc.

Witnessing of commissioning shall be a 3-stage procedure. The contractor shall initially verify to themselves that all tests have been successful and forward the associated commissioning paperwork to the consulting engineer for review. If the results tabulated are deemed acceptable by the Engineer, the commissioning and proving of the operation of each system shall be witnessed by the consulting engineer on site. Only once these results and associated operation of the various systems are proved acceptable and verified by the Engineer and all commissioning reports are fully completed, signed, dated and witnessed by the Engineer shall the systems be demonstrated to the Client and/ or their representatives.

The contractor shall also arrange for pre-client demonstrations on the operation of each of the mechanical installations and systems including the BEMS to take place in the presence of the consulting engineer. Only after successful demonstrations of all plant and equipment to the consulting engineer shall a date be organised with the Client for full Client demonstrations.

The contractor shall note that at each stage in the above process, the various system sub-specialists installer shall carry out the demonstrations to the Engineer and the Client not the contractor. This shall require multiple visits by all sub-specialists. No additional monies shall be granted for this works.

Please read the above in conjunction with Section 16 Commissioning Appendix at the rear of this specification.

2.26 CLIENT DEMONSTRATIONS

All Client demonstrations shall be recorded on a digital camcorder and the contractor shall be responsible for the recording of demonstrations of plant operation and compiling a DVD for handover to the Employer along with the completed Operation & Maintenance manuals and 'As Installed' documentation.

Demonstration and witnessing of commissioning shall be a 3-stage procedure. The contractor shall initially verify to himself that all tests have been successful and forward the associated paper work to the consulting engineer for review. If the results tabulated are deemed acceptable by the Engineer, the commissioning and proving of the operation of each system shall be witnessed by the consulting engineer on site. Only once these results and associated operation of the various systems are proved acceptable and verified by the Engineer and all commissioning reports are fully completed, signed, dated and witnessed by the Engineer shall the systems be demonstrated to the Client and/ or their representatives.

The contractor shall also arrange for pre-client demonstrations on the operation of each of the mechanical installations including the BEMS to take place in the presence of the consulting engineer. Only after successful demonstrations of all plant and equipment to the consulting engineer shall a date be organised with the client for full client demonstrations.

The works shall not be deemed Substantially Complete and ready for handover until all tests have been successfully demonstrated and the results confirmed as acceptable by both the Consulting Engineer and the Client.

Additional Client demonstration days shall be held approximately 1 week, 2 weeks & 4 weeks after the 1st demonstration day for the purpose of refreshing the Client after they have operated the systems for a given period. All sub-specialists must be in attendance on each day as requested by the consulting engineer and/or Client. No additional monies shall be granted for this works.

2.27 SUBSTANTIAL COMPLETION

All works shall be complete, tested, commissioned and appropriate paperwork handed over to the engineer for review prior to attending site to witness/verify and before he shall be in a position to issue the certificate of practical completion.

2.28 DEFECTS LIABILITY PERIOD

The Contractor shall remain liable for any noted defects and latent defects which may arise from the Works for a period of 12 months from the date of Substantial Completion. Contractual responsibilities in relation to the Defects Liability Period are detailed in the Conditions of Contract and in Part 2: General Responsibilities.

Any regulatory checks and inspections must be included by the contractors to carry out during the 12 months defects liability period, in particular mandatory Environment al Protection Agency (EPA) test on the Air Source Heat Pumps.

2.29 OBLIGATIONS AFTER SUBSTANTIAL COMPLETION

Between the issue of a certificate of practical completion and the certificate of making good defects relating to the whole or part of the sub-contract works, the mechanical contractor shall provide the following:

- A prompt call back service, available at all reasonable times, to attend to any faults and client operational queries.
- Carry out a final test at the end of the Defects Liability period to demonstrate to the Supervising Officer that the Sub-Contract Works are operating efficiently and that all components are functioning correctly.
- Carry out all work using competent, trained personnel, and except where made necessary by abuse, mis-use or negligence by other than the Sub-Contractor, make no charge to the Employer.
- Notwithstanding the foregoing paragraph, charge to the Employer the net cost of replacement for life-expired disposable parts.

- Return to site to complete the Energy Monitoring & Targeting set up on the BEMS front end following the 1st year of operation and carryout a final commissioning on the BEMS system.

3 M&E COORDINATOR ROLE AND RESPONSIBILITIES

3.1 GENERAL

The Main Contractor shall employ a full time M&E Co-ordinator for the duration of the contract works and their duties shall be as outlined below;

The M&E coordinator shall be responsible for guiding the overall M&E strategy and implementation of related activities within the project and with assistance of the M&E contractor sub-contractors provide timely and relevant information to project stakeholders. This will entail close communication with all involved in M&E design and coordination:

The M&E Co-ordinator shall act as an interface between the M&E contractor subcontractors and his own company contracting team, particularly but not being limited to matters for builder's work in connection with services. This role is distinct from a commissioning co-ordinator, however the M&E Co-ordinators role in commissioning is a final sign off before system demonstration to the M&E Consultants. M&E Co-ordinator under this contract shall adopt also the role of the commissioning Co-ordinator.

Critical tasks for the M&E Co-ordinator include setting up the M&E system and ensuring they are implemented effectively by relevant parties. This is undertaken through the joint development of a shared M&E system that is based on existing formal and informal mechanisms and systems within the Contract teams. This needs to be supported by ensuring that all parties have appropriate capacities for and undertake their own M&E activities, and to link these into an overall assessment of project progress and required actions. The M&E Co-ordinator shall be responsible for ensuring that adequate time is allocated for all M&E issues, in particular co-ordination items throughout the project, commissioning and demonstration, and ensuring that the construction programme allows for the building to be suitably ready to enable M&E installations to be fully witnessed and inspected, for example inspection of services prior to closing of ceilings, dust free environment prior to any system soak tests, intumescent strips installed on all fire doors prior to fire alarm testing to give an example.

The M&E Co-ordinator must ensure that sufficient time is allocated to consultants and clerk of work to allow inspection and any remedial works to be undertaken. This includes ensuring the M&E requirements described are developed and implemented in a timely fashion and in accordance with the design intent and BCar requirements. The M&E Co-ordinator shall also be responsible for making sure there are sufficient and appropriate personnel with the right level of resources and other support needed to implement good quality M&E installations and finishes.

The M&E Co-ordinator shall be based full time on site throughout the contract period. Particular emphasis shall be placed on the production, coordination and preparation of contractor coordinated construction issue drawings, development of fire systems C&E strategies based on the services and fire consultants design intent.

The M&E co-ordinator shall coordinate the commissioning, testing, demonstrations of all systems to the design team and client. A detailed commissioning programme shall be agreed with the contractors and their sub specialists which upon agreement shall be incorporated into the main contractors overall programme.

3.2 M&E Co-ORDINATOR RESPONSIBILITIES

The M&E coordinator's responsibilities shall include but not limited to the following:

- Coordination with M&E Contractors and Building trades
- To fulfil the role of on-site co-ordinator for the services installations.
- Responsible for supervising the M&E installations, reviewing & resolving daily co-ordination issues, reviewing of shop drawings and preparation of services drawings & to lead, manage and control relevant sub-contractors.
- Review and provide bi-weekly progress reports to the design team on the quality & progress of the M&E installations.
- To make design/installation decisions without external references where applicable.
- Be required to make design/installation decisions when they cannot be taken at site level and be able to contact the relevant person or company that would resolve the situation in the time period.
- Contract administration of M&E contractors subcontracts.
- Establish an effective M&E systems based on the technical specifications.
- Liaise with M&E contractors subcontractors on their work and the builder's work requirements and thereafter produce builders works drawings for comment by the design team prior to carrying out the works.
- Liaise with manufacturers of equipment and/or plant of provided, nominated or issued as part of the project installation requirements or have a direct impact on the installation methods or location restrictions.
- To co-ordinate on site relocation of services and/or terminal positions if any unforeseen clashes occur, within the constraints of the technical specification and the statutory requirements on locations of M&E services.
- Review monitoring reports analyse them for impact evaluation and to identify the causes of potential bottlenecks in project implementation.
- Undertake regular visits to the field to support implementation of M&E and to identify where adaptations might be needed.
- Resolving Conflict between contractors sub-contractors in matters of setting out and services positions.
- Liaison with contracting team on matters relating to and impacting on M&E Services.
- Manage Commissioning process
- Review and co-ordinate the contractors O&M, As Built and Health & Safety Information before transmitting to Design Team for final review.
- Confirm contractors subcontractor defects lists are completed and signed off prior to inviting the DT to inspect.
- Liaise with contracting team on any programming Issues.

- Ensure that all services are adequately protected by the main contractor during the full duration of the works contract. For example ensuring that containment & pipe work and all other services when installed are adequately protected from dust, dirt, debris and weather environment. Any services related installations found to be defected or damaged due to inadequate protection shall be replaced under this contract at No additional charge to the contract. It is imperative that the services co-ordinator fully makes their main contracting team aware of the importance of protection of services at all times.

3.2.1 Client & Design Team Liaisons

- Promote a teamwork approach with the Client, Client's Representative, Main Contractor, M&E contractors sub-contractors and their specialist sub-contractors.
- Liaise with the designers to resolve design queries and with the sub-contractors to ensure compatibility between systems.
- To create a comprehensive technical query schedule for both M&E works, incorporating information issued by the various sub-contractors.
- Negotiate approval for M&E changes to the project.
- Help M&E contractors to identify any project discretions with cost implications and implement an early warning system to inform and record any such implications to the client and design team.
- Distribute any changes or instructions provided by the employers representative.
- Provide to the Design Team any costs for design developments in a timely manner to enable decisions and or instructions.
- Prior to any formal technical submissions of services, check and review the M&E contractors sub-contractors submittals to ensure they meet the M&E Specification documentation including within the Equipment Schedules and drawings and when satisfied they are in compliance with the contract documents issue to the Design Team for review and comment in a timely manner.
- Assist the M&E contractors sub-contractors in providing a detailed cost profile in conjunction with the main contractor's programme for an overall spend profile and projected interim claims.
- Filter and Manage Requests for Information (RFI's) and Technical Query process, ensuring Contractors information requests are generated to allow a minimum of 10 working days for Design Team/Client Response.

3.2.2 Co-ordinated Drawings

- Prior to commencement of any installation works on site the M&E Co-Ordinator shall hold internal M&E co-ordination meetings with the M&E contractors sub-contractors to fully agreed routes and risers and co-ordination between all parties and only then prepare a full set of Mechanical & Electrical co-ordination drawings indicating the inter-relationship of all services and their relation to the structure and building fabric. Once the M&E co-ordinator is satisfied that the co-ordination process is fully detailed and complete, including a number of detailed sections, shall these co-ordination drawings then be issued to the Design Team for review and comment. It is the M&E Co-ordinators responsibility to ensure that the co-ordination process is fully complete prior to any works commencing on site. Please refer to General Responsibilities Clauses for details of Co-ordination drawings requirements.

3.2.3 Builders Works Drawings

- The M&E Co-ordinator shall be responsible for the production of builders works drawings. They shall agree open sizes with the M&E contractors. Upon agreement they shall mark up a builders works drawing and circulate to the design team for comment prior to forming any opens.

3.2.4 Working drawings and documents

- Upon completion of the M&E Co-ordination drawings the M&E Co-Ordinator shall prepare fully detailed Mechanical & Electrical services working/installation drawings for each of the individual services with the primary purpose of defining that information needed by the tradesmen on site to install the works. Please refer to General Responsibilities Clauses for details of Installation drawings requirements.
- Review of drawings and specifications and assist in the management of onsite changes.
- Review sub-contractor's documentation including method statements, test plans, quality assurance documents and risk assessments.
- Audit compliance with sub-contractors' systems.
- Shall be required to be self-sufficient to create your own site library for i.e. documentation files, construction drawings design schedules, minute files.
- To access the quality of the M&E design drawings, Construction drawings and M&E Technical schedules and comment on them accordingly.
- Check discrepancies between project drawings and technical specification.
- Ensure any drawings are issued in a timely manner to the design team for their comments and alterations thereafter.
- The M&E Co-ordinator shall keep on site available for reference by the Engineer or other members of the Design Team, a full set of their own Mechanical & Electrical Services working/installation drawings on which he shall record deviations as the work proceeds.

3.2.5 Testing & Commissioning

- Fulfil the role of commissioning co-ordinator engineer.
- Arrange to make available to the Design Team and Client, all in progress testing and commissioning throughout the duration of the project.
- Witness and record tests and inspections as required.
- Review the M&E programme and monitor installation, in progress testing and commissioning dates.
- To discuss the commission works for both M&E works with the various commissioning engineers and witness same to ensure their method statement is being adhered to.
- Provide support and arrange for factory inspections.
- Arrange for testing and commissioning of M&E systems including the handover of all replacements parts, warranties, operating manuals and maintenance tools and equipment.
- Lead Contracting team on all systems interface matters, for example between door furniture supplier, access controls specialist, fire specialist and ICT system etc.
- Prove all Cause & Effect strategies are operational before witnessing and demonstrations commence to the Design Team & Client.

- Ensure all systems are fully operational as per the design intent prior to demonstrations to design team.
- Ensure and record all instruments used is cover by a valid calibration certificate.

3.2.6 Health & Safety

- Monitor site safety, particularly with respect to electrical installations.
- Review and monitor the collation and hand over of final documentation including the O&M manuals.
- To review the 'as built' drawings, O&M documentation and Commission Documentation and ensure all sections are fully completed and an accurate reflection of that installed on site, prior to handover to the Design Team for final review and sign off.
- Monitor any toolbox talks on operating on/near live systems as and when they become live/operational and record documented proof of such talks.

3.2.7 Training & Handover

- Review and monitor the implementation of a training programme for system end users.
- Shall be required to organise Client hand over procedure, which shall include a demonstration of all services.
- Arrange all training sessions in a timely manner to ensure all Clients representatives, sub-contractors, design team and themselves can be in attendance.

3.2.8 Technical Meetings

- To chair technical meetings both on and off site.
- Ensure that the Co-ordination meetings are attended by all M&E sub-contractors and recorded.
- Distribute all M&E Co-ordination meeting minutes to the Design Team for their action/attention in a satisfactory time period from each meeting to ensure each item can be attended to.

3.2.9 In Progress installation & monitoring

- Prepare M&E risk assessments and method statements, works schedules and snagging schedules.
- Make comments on the items of M&E works included within the construction master programme.
- Assist in the deployment and storage of M&E materials, plant and equipment delivered by the M&E contractors sub-contractors.

3.2.10 Installation Quality Control

- Comply with the M&E specifications and drawings, statutory regulations, code of practices and good working practices.
- Supervise and inspect all M&E works carried out by M&E contractors sub-contractors.
- Supervise completion of in progress snagging and testing.

- Ensure all defects have been rectified prior to commissioning/demonstration of systems to the Design Team and Client.

3.2.11 Final Testing, Commissioning and Demonstrations

- Perform the duties of a commissioning coordinator for all their tasks below.
- The Co-ordinator shall be responsible for ensuring that a commissioning plan is in place for the entire project, showing clearly how the project will be commissioned and handed over.
- The commissioning programme shall include details of all Mechanical, Electrical & Lift systems and how the completion of Building Works within each phase will be impacted by this process.
- The Co-ordinator shall ensure that all calibration documentation, test record sheets and commissioning figures are fully completed and included within the O&M's and for co-ordinating the end user demonstrations for all Mechanical, Electrical and Lift Services.
- The Co-ordinator shall also be responsible for ensuring that full load tests on installed equipment do not interfere with any Client held areas of the building and liaising with the Design Team and Client to ensure a complete solution is provided.

3.3 BUILDING CONTROL AMENDMENTS REGULATIONS 2014 (BCAR)

- At the end of the project the M&E Co-ordinator shall be responsible for compiling the M&E contractors sub-contractors and their sub-sub specialists obligations in completing CIF Ancillary Certificates for the project, reviewing that the certificates are fully completed and only then shall forward to the Design Team for review and comment in a timely fashion. Please refer to Project Particulars of the M&E Specifications for details of the requirements.

3.4 M&E CO-ORDINATOR QUALIFICATIONS & COMPETENCES

- A copy of the CV of the proposed Co-ordinator should be included by the main contractor at Tender Return for review and comment by the design team.
- Proven track record in the successful design, implementation and evaluation of comprehensive M&E systems.
- Current knowledge of various M&E methods and tools, including outcome mapping.
- Familiarity with the collection and analyses of M&E data.
- Experience in M&E project management.
- Sound judgement and an ability to professionally deal with sensitive issues.
- Ability to multitask and change to priorities, systems, processes and statutory requirements.

4 REMOVALS (50)

4.1 GENERAL

The following information details the requirements for all mechanical removals works necessary for the completion of this Contract. Where shutdowns of existing services are required to facilitate the works, the Contractor shall agree these with the School in advance. For programming of removals, see Contract Preliminaries.

All disposals shall be carried out in accordance with current legislation.

4.2 EXISTING PLANTROOM

Isolate, disconnect and remove the following within the school Plantroom:

- 2 no. gas fired sectional boilers and burners
- Gas boiler flues
- All primary LPHW pipework and flow & return headers, cut back existing circuits sufficiently to allow for the installation of new pipework and headers
- Gas service pipework up to and including the existing slam shut valve
- All redundant power isolators, wiring and containment
- All heating controls, field devices, wiring and containment
- 1 no. gas fired storage water heater
- 2 no. DHW Buffer Tanks
- 2 no. Expansion Vessels
- All primary plumbing pipework, cut back existing MWS, CWS, HWS & HWR sufficiently to allow for the installation of new pipework

Heating for the new school extension and existing buildings will be provided for by a low carbon bi-valent operating plant consisting of a mixture of Air to Water Heat Pumps and high efficiency, natural gas fired condensing boilers. The Air Source Heat Pumps shall be the primary form of LPHW heating and shall be capable of providing an LPHW flow temperature of 55°C(70°C for existing school), under peak operating conditions when the external air temperature is -3°C dB.

The heat pumps will be designated as the lead heat source, operating throughout the year to provide the heating demands for the new extension building and existing buildings. A natural gas boiler array will assist the heat pumps during periods of colder weather to achieve desired design temperatures, then switch off as set points are achieved. The Bivalent system will be designed to operate in parallel.

Each ASHP shall be provided complete with its own Hydraulic Kit c/w primary circulating pumps to circulate the primary LPHW heating water to the LPHW heating buffer vessels within the Heating Plantroom and back.

The heat pumps shall be provided with a primary loop pump positioned on the return water side of the heat pumps. This pump will be located externally at the heat pumps. The primary pump are to be controlled by the BMS. The primary pump are to be variable volume, controlled by a pressure differential over the pump set. The primary pump will circulate low temperature hot water between the heat pump and a large buffer vessel, which will be located internally within a Plantroom. The primary loop shall be provided with a heat meter positioned on the return circuit to the heat pumps to provide kilowatt hour data on the thermal output of the heat pumps. Electrical supplies to the heat pump shall be fitted with electrical meter to enable full monitoring of consumption and output data.

The buffer vessel will be sized based on the thermal capacity of the heat pump but will also be sized to accommodate heat pump defrost cycles, in the event that heat pump could possibly be defrosting simultaneously when serving the same the load. The buffer shall maintain a mean water temperature of 55°C(70°C for existing school) and shall be provided with a series of probe temperature sensors mounted vertically along the face of the buffer to provide temperature monitoring and demand indication to heat pumps to modulate heating power accordingly.

Where pipework between the heat pump and the buffer vessel travels underground, it shall be semi rigid, pre-insulated, pipework to limit transient heat losses as much as possible.

Where pipe work needs to be installed externally above ground it shall be heavy gauge steel and shall be insulated with rigid foam insulation, weather protected and hammer clad to provide some mechanical protection. All external valves, pumps, and accessories shall be provided with insulated valve jackets.

All pipework located within the internal Plantroom shall be medium gauge steel, insulated with rigid foam insulation and valve jackets provided.

The minimum Efficiencies & SCOP are outlined in the Part 4: Equipment Schedule which are required under EN14825 to meet the NEAP requirements for Building Regulations Conformance.

The Air Source Heat Pumps must have fans / pumps and be ErP compliant.

The heat pump package supplier must provide full schematics showing COPs, flow-rate, loads and power input for the overall system and for each item of equipment at all design conditions.

All equipment must be registered on the SEAI Triple A Register.

Heat pumps shall be positioned with adequate accessible space on all sides for maintenance and circulation. Use anti-vibration mounting arrangements in all installations.

The Contractor shall provide for full servicing of the Air Source Heat Pumps by the manufacturer manufacturer with support from a local representative who shall remain on site for a period of one week after handover to monitor and report on system performance. In addition, the local representative shall provide service visits at the following intervals post handover:

- Month 3 – monitor and service visit
- Month 6 – monitor and service visit
- Month 9 – monitor and service visit
- Month 12 – monitor and service visit (full service of all equipment, post assessment visit to provide plant adjustments as required following client one year energy report).
- Month 24 – monitor and service visit (full service of all equipment, i.e. heat pumps, pressurisation units, pumps, etc).

Refer to drawings and schematics and Part 4: Equipment Schedule for further details on the Air Source Heat Pump.

5.4 BOILER PLANT

The Contractor shall supply, install test and commission fully packaged cascading wall mounted modulating Natural Gas fired boiler plant in the 2no. Heating Plantrooms as an assist to the electric Air Source Heat Pumps primary plant. The boilers shall be provided with their own individual concentric flues, weather compensating cascade controllers, hydronic header and low loss flow and return headers. Please refer to Part 4 - Equipment Schedule for technical performance specification.

The Contractor shall commission all boilers to maximise condensing within the 2no. Heating Plantrooms and shall provide for full servicing of the boilers before handover and again before the end of the defects period.

Floor-mounted boilers shall be positioned with burners facing the external doors and shall have adequate accessible space on all sides for maintenance and circulation. Access shall be provided for the fitting and removal of boiler sections where required with minimum disruption to other plant.

The boilers shall be fitted with normal mounting and include pressure gauge, enclosed spring safety valve piped to low level for safe discharge, dial type mercury thermometer and draw-off draincocks with hose connections. Each boiler shall have a permanently fixed notice, 200mm x 200mm, screwed to the boiler casing with the following wording: "Important Notice. Do not reduce the boiler operating flow temperature below 85°C".

Each boiler shall be supplied with a horizontal balanced flue which shall discharge exhaust flue gases to atmosphere. The intake air for combustion shall be via the balanced flue.

The boilers shall be supplied as a package with their own proprietary Cascade System Kit comprising north facing temperature sensor, main flow and return pipework, main gas pipework, boiler piping set, configuration supports and mounting frame. Each boiler shall also be supplied with its own modulating pump.

It is imperative that the boilers proposed have a stainless steel heat exchanger.

All boiler plant shall be supplied with volt free contacts and suitable for taking a BEMS connection for enable / fault.

The Contractor shall provide for full servicing of all boiler plant before handover and again before the end of the defects period.

5.5 BOILER FLUES INSTALLATION

Flues shall be installed from each boiler as a pre-fabricated horizontal discharge balanced flue systems. Flues shall be of powder-coated construction and shall be run without bends at an upwards slope to allow condensate drainage back to the boilers. Horizontal wall terminals shall be mounted at not less than 2.5m above the external finished ground level to the underside of the terminal. Exit points for flue terminations shall comply with current Irish standards. In addition, flues shall not be located within passageways or underneath windows of occupied rooms. Where a flue is located adjacent to a play area, a protective stainless steel cage shall be provided to protect against ball damage. See Part 4: Equipment Schedule for further details.

The mechanical contractor is responsible for getting their flue specialist to calculate the final flue size based on the hot water heater purposed as part of their technical submittal and the flue lengths and fittings based on their co-ordinated working drawings and forward to the Consulting Engineer for review.

5.6 LPHW DIRECT BUFFER VESSELS

Vertical LPHW/LPHW floor standing direct buffer vessels shall be provided in each Heating Plantroom as indicated on the design drawings and schematics with a performance specification as outlined in Part 4 Equipment Schedules. The buffer vessels must be fully insulated to provide a B or C thermal rating in accordance with ErP requirements.

Refer to design drawings and schematics, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the Buffer Vessels.

5.7 LPHW CIRCULATING PUMPS

LPHW circulation pumps shall be installed in each Heating Plantroom as detailed on the design drawings and schematics and in Part 3: Standard Specification and Part 4: Equipment Schedule. LPHW circulating pumps shall be supplied with Differential Pressure Transducer Kits for sealed circuits and volt free contacts for connection to the BEMS for enable/fault.

All pumps associated with heat plant shall be selected in conjunction with the product supplied. Pump duties listed on engineers drawings reflect the design intent. Product selection shall be based on the working equipment selected. It is the contractor's responsibility to ensure that the pumps supplied are matched for the installed equipment.

Pumps shall be single head high efficiency inline constant pressure variable speed pumping units, which shall utilize their own on board variable speed drives to minimise energy consumption associated with pumping water at part load capacities.

Comply with manufacturer's recommendations regarding application and installation of pumps. For in-line pumps ensure that motor is positioned in accordance with manufacturer's requirements. Use anti-vibration mounting arrangements in all installations.

See drawings, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the LPHW Circulating pumps.

5.8 PRESSURISATION UNITS & EXPANSION VESSELS

Twin pump pressurisation units and expansion vessels shall be provided suitable for the system duties as outlined in the Part 4: Equipment Schedules. The pressurisation units shall have volt free contact and capable of being linked to the BEMS to monitor high and low pressure and report faults to the BMS. All break-tanks and expansion vessels shall be located away from wall vents and doors.

The Contractor shall provide for full servicing of the pressurisation units before handover and again before the end of the defects period.

See drawings, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the LPHW Pressurisation Unit & Expansion Vessel.

5.9 DOSING POTS

The Contractor shall supply and install chemical dosing pots as indicated on the design drawings and schematics which shall come complete with fill point and all necessary isolating valves. See drawings, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the dosing pot.

5.10 AIR / DIRT SEPARATORS

The Contractor shall supply and install air/dirt separators on the primary flow & return heating pipework from the ASHP's as indicated on the design drawings and schematics.

See design drawings and schematics , Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the air / dirt separators.

5.11 THERMOMETERS & PRESSURE GAUGES

Thermometers and pressure gauges shall be installed as indicated on the design drawings and schematics and as detailed in Part 3: Standard Specification.

5.12 VALVES

Isolating, double regulating, commissioning sets and control valves shall be installed as indicated on the design drawings and in accordance with Part 3: Standard Specification. The distribution system shall be provided with adequate drain cocks at all low point to facilitate sectional maintenance and repair works. For the purposes of tendering, valves shall be taken as nominal line size.

The contractor shall ensure that adequate access is provided for maintenance of all plant and equipment and that all valves are readily accessible.

5.1 PRE-INSULATED HEATING PIPEWORK

The contractor shall supply, install and test pre-insulated heating pipework suitable for installation underground. This pipework shall connect enable flow of heating between the external heat pumps to the internal heating centres buffer vessels as indicated on the design drawings with a performance specification in accordance with Part 4: Equipment Schedule.

The pre-insulated pipework shall be a bonded pre-insulated, self-compensating and flexible piping system suitable to transport low temperature hot water from a heat source underground losing minimal heat.

A separate, single, pre-insulated pipe shall be installed for both the flow and return for each heat pump. Dual pipes within the same pre-insulated medium is not acceptable. The pre insulated heating pipework shall have a minimum heat loss of 0.216 W/m. Insulation shall be closed cell PUR foam wrapped in a corrugated HD PEXa. The inner tube of the pipework shall be bonded to the insulating foam to create a closed cell, preventing water ingress in the event of damage. The pipework shall be capable of operating temperatures of 95°C and it shall be tested to 6 Bar.

The contractor shall be responsible for reviewing proposed pre-insulated product with their proposed selection of heat pumps. The pipework shall be selected that the pressure losses shall be within acceptable tolerances of the main primary loop circulation pump from the proposed heat pump product. The pump shall be advised by the heat pump supplier. If pipework needs to be increased in size to reduce pressure losses to meet heat pump tolerances, this shall be done at no additional cost to the contract. Pipe sizes indicated on the tender drawings are from design intent and products/pressure losses of design intent can be advised by consulting engineer on request.

5.2 LPHW HEATING PIPEWORK & HEADERS

All LPHW heating pipework shall be medium grade black mild steel tube to EN 10255:2004 Medium as detailed in Part 3: Standard Specification. Pipework shall be installed to form a two-pipe flow and return heating system.

All heating pipework shall be fully painted (red lead) upon completion of installation and prior to thermal insulation being applied.

All pipework up to 50mm shall have screwed joints, pipework 50mm above shall be welded. All large pipework in Heating Plantroom areas shall be flanged to facilitate easy removal if required.

Headers shall be fabricated with 2 no. sets of blanked and valved stubs to allow for installation of future circuits, sized as shown on the drawings. In addition, 1 no. set of blanked stubs shall be provided at the supply end of the headers to facilitate the future installation of a packaged renewable energy plant via a plate heat exchanger.

5.3 PIPEWORK SUPPORT

The Contractor shall include for the provision of pipework support including installation of box brackets and unistrut brackets as required.

5.4 PIPEWORK & VALVE LABELLING

Appropriate colour identification bands and flow directional arrows shall be affixed to all insulated pipework inline with BS 1710: 2014. All valves within the Plantroom shall be provided with an engraved plastic circular label numbered to correspond with a wall-mounted valve chart erected in the Plantroom upon completion of the contract. A valve chart shall also be provided as part of the Contractors completed O&M manuals.

5.5 THERMAL INSULATION

All expansion vessels, break-tanks, pipework and valves within the Energy Centre, in casings, voids or attic spaces shall be fully insulated with preformed sections of rigid mineral wool incorporating an aluminium foil laminate cover as detailed in Part 3: Standard Specification and shall be fitted in accordance with the manufacturer's instructions. The insulation shall also be applied to all connections, bends, tees and valves.

All insulation shall be fitted in accordance with the manufacturer's instructions. All heating and plumbing pipework, valves and ancillary equipment within Heating Plantroom areas shall be insulated and aluminum hammer clad to provide mechanical protection.

Where pipework is installed externally it shall be fully insulated with preformed sections of rigid mineral wool incorporating an aluminium foil laminate cover as detailed in Part 3: Standard Specification and wrapped in PIB and encased in Aluminium hammer clad for environmental and mechanical protection.

Proprietary jackets with Velcro fixings shall be used on all valves over 25mm. Additional taping every 2 m shall be provided on the insulation within the Energy Centre.

All insulation shall be Class A1, CFC and HCFC free with ozone depletion factor of zero.

Thermal conductivity shall not exceed 0.042 Wm²K at 100°C and thickness shall be in accordance with the following:

Pipe Diameter	15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm
Insulation Thickness	20mm	25mm	25mm	40mm	40mm	40mm	40mm	40mm

Refer to Part 3 Specification Section 2310 Non-Domestic Heating Installations – Mineral Wool for more details.

5.6 AIR VENTING

Air vents shall be provided as necessary and be installed at the highest points of heating pipework installation. Each air vent shall be controlled by a lock-shield valve and air release pipes shall run to discharge at the nearest suitable visible point outside.

5.7 DRAIN COCKS

The heating pipework shall be installed to a gradient to allow effective draining down when required. All low points shall be fitted with drain cocks. The contractor shall indicate all low and high points and clearly indicate these on their 'As Installed' drawings.

5.8 CORROSION INHIBITOR

Prior to Practical/Substantial completion a corrosion inhibitor with combined anti-freeze protection shall be added at a 5% system content ratio to the heating system by a specialist sub-contractor. The contractor shall note all types of heat emitters, pumps, heating plant and heat exchangers associated with the heating systems and ensure that the type of inhibitor used should not adversely affect such equipment, in particular the capacity of the heating circulating pumps and the heat exchanger within the Boilers and Air Source Heat Pumps.

5.9 ANCILLARY BOILER ROOM HEATING

The Contractor in addition to the above shall supply and install an electric oil-filled wall-mounted heater in the Plantroom adjacent to the pressurisation unit. It shall be controlled by a frost thermostat located beside the Plantroom doors. For further details refer to Part 4: Equipment Schedule.

5.10 TANK ROOM HEATING

The Contractor shall supply and install an electric oil-filled wall-mounted heater in the Tank Room. It shall be controlled with a local room thermostat. For further details refer to Part 4: Equipment Schedule.

5.11 SYSTEM PARAMETERS

Heating zones shall be clearly indicated on a colour coded A3 sized drawing, which shall be laminated, framed and screwed to the wall adjacent the BMS panel.

All valves within each Heating Plantroom shall be individually tagged with traffolite circular tags with a corresponding valve chart laminated, framed and screwed to the wall.

Prior to any filling and venting of the new LPHW systems the Contractor shall be responsible for pressure testing all new heating pipework and shall give sufficient notice to the Consulting Engineer / ER to allow pressure testing of pipework to be witnessed. Signed and dated pressure testing certificates will be required in the O&M manual.

The Contractor shall be fully responsible for pressure testing, flushing, filling and venting the new heating installation in line with Part 3 of the Specification.

The Contractor shall be responsible for completely hydraulically water balancing the new LPHW heating systems to water flowrates advised by the Consulting Engineer. All certificates

shall be signed and dated by the contractor and witnessed by the Consulting Engineer / ER (signed and dated) prior to insertion into the O&M manual.

As the system is operating at elevated temperatures and pressures special care shall be taken when working on the system.

Automatic air vents shall be provided at high points within the system. Capillaries from AAV's shall be piped to low level to a tundish with associated discharge pipes to external. The pipework shall be installed to a gradient to allow effective draining down when required. All low points shall be fitted with drain cocks. The contractor shall indicate all low and high points and clearly indicate these on their 'As Built' installation drawings.

The contractor shall ensure that straight lengths of pipework are provided at key flow measurement points. Flow measurement points are to be provided a minimum equivalent of 10 pipe diameters upstream of any bends or fittings etc.

The entire installation shall be tested and commissioned and set to work in accordance with the Commissioning Appendix at the rear of this specification and Part 3 of the Specification and Good Practice requirements.

Where pipework passes through a fire rated partition i.e. wall, floor, ceiling etc a photographic record linked to a unique number identifier and marked on a drawing. Certification shall comprise two elements – Specialist fire stopping certification (e.g. through floor/wall penetrations, sealing of pipes, provision of fire collars etc) and General Contractor fire stopping (fire stopping around door frames and general internal fire rated partitions). All opes shall be fully sealed with a fire stopping material whether they are through a fire compartment or not.

6 (52) SOILS & WASTES INSTALLATION

6.1 GENERAL

Carry out work in accordance with the current Building Regulations Technical Guidance Document 'H', EN 12056-2:2000 and BS 6700. On delivery check that all components are in accordance with the requirements and are free from defects and damage. Reject any incorrect, defective or damaged items. Unless otherwise indicated, obtain all components from the same manufacturer.

Store delivered components in secure weatherproof accommodation, as recommended by the manufacturer. Ensure that the storage method does not cause damage to the components.

6.2 SANITARYWARE

The sanitaryware shall be specified by the Architect and provided by the Main Contractor. The Mechanical Contractor shall be responsible for taking delivery of the sanitaryware from the Main Contractor on site and shall be responsible for fitting of the sanitaryware as detailed in the Bill of Quantities and as indicated on the Architect's drawings. On delivery to site, all sanitaryware should be checked for defects and damage. Items should be stored by the Contractor in secure weatherproof containers as recommended by the manufacturer until all items are being installed.

The Mechanical Contractor shall also be responsible for removal from storage and carriage to the position, erection of each item and all connections to and from the sanitaryware as detailed on the drawings and within this specification.

All sanitaryware shall be fitted in accordance with Part 3: Standard Specification, but in general the following points shall be closely adhered to:

- The Contractor shall be responsible for all services to and from each item of sanitary ware throughout the installation.
- All sanitaryware showing visible cracks or crazing before or during the Defects Liability Period not caused by physical damage shall be replaced free of charge by the contractor. The contractor shall also be responsible for employing the contractor to fit the replacement items.
- On each sink and basin hot taps shall be fitted on the left and cold taps on the right.
- All items of sanitary ware shall be left in a clean and acceptable condition with all protective paper and debris etc. removed.

6.3 PIPEWORK INSTALLATION - GENERAL

Soils and Wastes pipework shall be installed in uPVC piping and suitable for operating temperatures of 70°C as detailed in Part 3: Standard Specification with the exception of the Science Classrooms and Preparation Areas which shall be a chemically resistant solution, suitable for application. uPVC pipework suitable for above ground Soils and Wastes installations is usually black, white or grey pipework. Terracotta coloured pipework is only suitable for drainage below ground and must not be used above ground.

All pipework installed in ceiling voids must be jointed using solvent welds to prevent leakage and damage to building fabric. All fire-sleeves, vents, anti-syphons and traps shall be included as required. Blank caps, rodding eyes or cleaning doors **MUST** be provided at all changes of direction to allow access for cleaning rods.

The Soils and Wastes installation on the ground floor shall generally connect directly to builder's floor sockets. The exact setting out of floor sockets to suit the sanitary ware or any other equipment to be installed shall be the responsibility of the Main Contractor, however the Mechanical Contractor shall make a representative available to the Main Contractor to assist with the planning and setting out of all ground sockets and also all Soils and Wastes points throughout the building.

Within the Dental Studies Practise, sink waste pipework shall be installed in chemical resistant pipework solution suitable for application to a dilution pot of minimum 4.5 litre capacity as detailed in Part 3: Standard Specification. Please note that all pipework installed in ceiling voids must be jointed using solvent welds to prevent leakage and damage to building fabric.

Air admittance valves shall not be used on this project, except by express permission of the Employer's Representative.

All water storage tanks overflows shall be installed in two sizes bigger than the supply main feeding the tank with the overflow pipework within the water tank room piped to discharge externally as indicated on the design drawings to create a 'nuisance'.

All Soils and Wastes pipework shall be laid to falls at a minimum of 1:50 and maximum of 1:80, unless otherwise noted.

6.4 SOIL VENT PIPES

The Contractor shall install Soil Vent Pipes as indicated on the design drawings and as detailed in Part 3: Standard Specification. Fire sleeves shall be installed where pipework passes through fire rated floor slabs and as detailed in Part 3: Standard Specification. All vent pipes shall terminate at a minimum height above roof level of 450mm c/w wire balloon grating/cowl.

6.5 ACCESS POINTS IN DRAINAGE PIPELINES

Locate access points in the following positions: -

- 1) At the end of all waste pipes.
- 2) At all changes in direction
- 3) At right angle bends.
- 4) At branches in iron pipelines.
- 5) At the foot of all soil stacks and rainwater stacks.
- 6) At any other location necessary to allow complete rodding of the system, or as scheduled.

Site access points in drainage pipelines to facilitate entry of cleaning tools and equipment.

6.6 FIRE SLEEVES

Provide fire sleeves on all uPVC pipework as scheduled below where pipes pass through floor slabs and fire compartment/sub compartment walls as indicated:

- UPVC soil & waste pipes - above 38mm

On all pipework passing through walls or floor slabs, which do not require the fitting of fire sleeves, provide sleeve of next pipe size and fill annular space between with intumescent mastic.

6.7 SYSTEM REQUIREMENTS

All traps shall be minimum 75mm deep seal anti-syphon traps.

Workmanship, Installation and identification shall be in accordance with Part 3: Standard Specification.

All pipework shall be fixed to the building fabric and supported in accordance with Part 3: Standard Specification.

Testing, Commissioning and setting to work shall be in accordance with Part 3: Standard Specification, manufacturer's recommendations and all relevant guidelines.

The entire system shall be installed in accordance with Part 3: Standard Specification and Manufacturers Standards.

7 (53) PLUMBING INSTALLATION

7.1 GENERAL

The following information details the requirements for all internal mains, hot & cold water installation works necessary for the completion of this Contract. All aspects of the installation must be installed in accordance with prevailing national and international standards, with a specific focus on the prevention of legionella.

Install all domestic water services with the guidance contained in CIBSE TM13 'minimising risk of Legionnaires' disease' and HSE ACoP L8 legionnaire's disease-control of legionella bacteria in water systems.

All water services systems should be installed in accordance with BS 6700 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages and CIBSE Guide G Public Health Engineering.

On each sink and basin hot taps shall be fitted on the left and cold taps on the right.

Note: All equipment and fittings on the mains, hot and cold systems in each building shall be suitable for operating on a pressurised supply.

7.2 WATER STORAGE TANKS

All water storage tanks shall be pre-insulated, sectional, GRP type suitable for the provision of potable water to Format 30.

A new potable cold water storage tank shall be located in the dedicated water tank room in the roof space of the new extension.

All cold water storage tanks shall be installed to Format 30 and split in two equal halves to facilitate maintenance and shall be provided with a single piece drip tray underneath and have adequate access all round for future maintenance. Each supply inlet shall be fitted with a ballcock. Motorised valves or float switches are not acceptable. Overflow pipes fitted with non-return valves and drip-tray overflows shall be discharged externally to a point of nuisance. Access hatches shall be located to provide a minimum of 750mm overhead clearance for safe access.

Refer to Part 4: Equipment schedules for technical performance specification on the water storage tanks.

7.3 LPHW / DHW INDIRECT PRE-HEAT CYLINDER

Vertical LPHW/DHW floor standing indirect tank-in-tank quick recovery pre-heat Domestic Hot Water cylinders shall be provided in the Plantrooms as indicated on the design drawings and schematics with a performance specification as outlined in Part 4 Equipment Schedules. The DHW Indirect pre-heat cylinders shall be the rapid recovery type with low maintenance requirements and a stainless steel cylinder and must be fully insulated to provide a B or C thermal rating in accordance with ErP requirements.

The indirect Domestic Hot Water pre-heat cylinders must be capable of heating the contents of the cylinder from 10°C to 50°C from the Air Source Heat Pumps and shall be provided with a fully removeable anti-legionella carbon steel heating coil, which shall be fed from a higher temperature boiler heating circuit to provide pasteurization of the contents of the cylinder on a time schedule to mitigate against the proliferation of legionella. The cylinders must be provided with a 6kW electric immersion and be WRAS / KIWA approved and suitable for storing and conveying Domestic Hot Water.

Refer to design drawings and schematics, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the Indirect pre-heat cylinders.

7.4 DOMESTIC HOT WATER HEATERS

Floor standing direct gas fired quick recovery condensing Natural Gas fired water heaters shall be provided as detailed on the drawings and schematics and outlined in Part 4: Equipment Schedules. The water heaters shall have a stainless-steel heat exchanger, integral direct storage vessel with fully modulating burner designed to provide continuous modulation from 100% to 20% by controlling the gas/air ratio. The gas burner shall be suitable for Natural Gas.

The gas fired water heater shall be room sealed with a concentric flue which shall exit each Plantroom to exhaust at high level.

Refer to Part 4: Equipment schedules for details on the Natural Gas fired Hot Water Heaters.

7.5 FLUE INSTALLATION

The Contractor shall supply & install balanced flue from the gas fired hot water heater as specified in the Part 4: Equipment Schedules. The flues shall exit the Heating Plantroom at high level to discharge horizontally to atmosphere. The concentric flue shall be installed strictly in accordance with the manufacturer's recommendations and statutory requirements.

The exhaust flue shall be adequately supported throughout its length using the manufacturer's load bearing and lateral support components. Please refer to Part 4: Equipment schedules for specification on the flues.

The mechanical contractor is responsible for getting their flue specialist to calculate the final flue size based on the hot water heater purposed as part of their technical submittal and the flue lengths and fittings based on their co-ordinated working drawings and forward to the Consulting Engineer for review.

7.6 COLD WATER BOOSTER SETS

A cold water booster set shall be supplied, installed, tested and commissioned under this contract. The booster set shall be the twin pump model and shall be a packaged unit with all integral valves, drains, pressure vessels etc and shall be supplied with volt free contacts for connection to the BMS. The booster set shall provide boosted cold water to all sanitaryware throughout each school building with a separate boosted cold feed to the gas fired hot water heater which in turn shall provide boosted hot water to all sanitary fittings as required. Pressure reducing valves shall be provided as required to reduce the pumping pressure in the distribution system.

Please refer to Part 4: Equipment Schedules for technical performance specification on the Cold Water Booster Sets.

7.7 WALL HUNG WATER BOILER

The Contractor shall provide wall hung water boilers as indicated on the design drawings as per the Part 4: Equipment Schedules. These units shall provide potable steam free boiling water for tea/coffee making. The water boilers are to be wall-mounted over a sink draining board area and complete with stainless steel drip tray and waste and an integral 7-day digital programmer. Refer to Architects Room Elevation drawings for correct mounting positions.

7.8 MAINS WATER SUPPLY & DISTRIBUTION

The Main Contractor shall be responsible for locating the existing mains water supply in the 2010 extension building and extending a new mains water supply to the new extension as indicated on the design drawings.

A new non-metallic pipework and distribution system shall be connected to the mains water supply and shall be distributed around the school building in ceiling voids as indicated on the design drawings. Please refer to the plumbing drawings and schematic for valving arrangement.

Mains water shall be distributed in non-metallic pipework as outlined as follows in Technical Guidance Document 031.1 Guidelines on Mains Water Distribution Systems in Post Primary Schools which outlines in section 2.2.1 item (g) *'In order to reduce the risk of metallic exceedances in a mains water supply feeding drinking water outlets, in particular Lead and Copper, a complete non-metallic pipe work solution should be provided on a Mains Water Distribution System only in schools'*. Please note all valves and pipework fittings that shall be installed on the mains water distribution system shall also be non-metallic. The mains water distribution system shall be suitable for potable water and suitable for operating temperatures and pressures.

7.9 MAINS WATER LABELLING

Drinking water taps shall be labelled with engraved traffolite type labels. Distribution pipework shall be labelled at regular intervals and prior to sanitaryware connections as detailed in Part 3: Standard Specification.

7.10 MAINS WATER TESTING

A test point shall be provided on the mains water supply in the Plantrooms to allow water samples to be taken to verify water quality.

Prior to handover, the Contractor shall arrange to have samples from a mains water drinking tap tested for compliance with S.I. No.122 of 2014 - European Union (Drinking Water) Regulations 2014. Testing shall be carried out by an NSAI accredited test laboratory. The original report and results must be forwarded to the ER and an additional copy included in the Health & Safety File. Compliant results must be achieved before handover can take place.

During the Defects Liability Period, a second mains water sampling operation shall take place nine months after handover to ensure continuing compliance with S.I. No.122. Any failure to meet the drinking water standards will require remediation by the Contractor before the issue of the Final Certificate on the Contract.

7.11 MAINS WATER COMMISSIONING & HANDOVER

As-installed drawings shall include a confirmation of the volume of the total mains water distribution system (i.e. from the inlet point in the new Plantroom to the cold-water storage tank connection).

The Health & Safety file shall include a record of materials used for the mains water distribution system and a copy of the EU approval documentation for their use in mains water and drinking water systems.

Handover demonstrations shall include an explanation of the maintenance instructions as detailed below.

7.12 MAINS WATER MAINTENANCE SCHEDULE

The Health & Safety File shall contain the following maintenance instructions:

- The mains water system shall be fully flushed at the end of each holiday period by allowing the flow of the stated volume of the mains water system to run to drain. Instructions shall include the specification of a designated tap at the end of the distribution system and a calculated flushing period (based on the given flow-rate of the designated tap).
- All drinking water usage points (including water boilers) shall be opened to allow flushing of dead leg volumes. Instructions shall include an estimated standard flushing period for all outlets.

7.13 COLD WATER DISTRIBUTION

All cold-water pipework shall be installed throughout in copper table 'X' pipework to IS EN 1057 and BS 12449:2016 as detailed in Part 3: Standard Specification and as indicated on the drawings. All soldered fittings shall be of the lead free non-dezincifiable type.

A cold water booster pump/set shall be installed on the outlet to the tank to provide adequate pressure for the hot and cold water distribution throughout. For further details, see drawings and Part 4: Equipment Schedule.

7.14 HOT WATER DISTRIBUTION

Hot water shall be distributed from the school Heating Plantrooms in copper table 'X' pipework to IS EN 1057 and BS 12449:2016 and as detailed in Part 3: Standard Specification and as shown on the drawings. A new domestic hot water recirculation system shall be installed with a domestic hot water return pump fitted on the inlet to the DHW Pre-Heat Cylinder as indicated on the design drawings and schematics and as detailed in Part 4: Equipment Schedule to ensure the hot water is returned to the water heater at no less than 50°C in order to mitigate against the proliferation of legionella. All soldered fittings shall be of the lead free non-dezincifiable type.

Domestic hot water must be circulated throughout the school hot water system at a minimum temperature of 55°C in order to protect against legionella. Commissioning data must include pipework temperatures measured throughout the system to guarantee that all sections of the return system are operating at the required temperature.

In compliance with ACOP L8, the contractor should ensure no dead legs are created either in new installations or modifications to existing systems.

7.15 DOMESTIC HOT WATER CIRCULATING PUMP

DHW circulation pumps shall be installed in the school Heating Plantrooms as detailed on the design drawings and in Part 3: Standard Specification and Part 4: Equipment Schedule. The DHW circulating pump shall be of bronze or stainless steel construction and suitable for installation on potable domestic water systems and shall be provided with volt free contacts for connection to the BEMS for enable/fault.

The DHW return pumps shall be single head high efficiency inline constant pressure variable speed pumps, which shall utilize its own on board variable speed drive to minimise energy consumption associated with pumping water at part load capacities.

Comply with manufacturer's recommendations regarding application and installation of pumps. For in-line pumps ensure that motor is positioned in accordance with manufacturer's requirements.

See drawings, Part 3: Standard Specification and Part 4: Equipment Schedule for further details on the DHW circulating pump.

7.16 THERMOSTATIC MIXING VALVES

A TMV 3 standard failsafe, lockable Thermostatic Mixing Valve c/w integral strainers and non-return valves shall be provided to all sinks and wash hand basins with a hot a cold water supply throughout the school with the exception of the cleaner's sink. The mixing valves in each school buildings shall be suitable for a booster/pressurised system to maintain a similar pressure differential for mixing purposes.

All valves must be set and tested for an outlet temperature of 41°C and not more than 43°C in order to protect against anti-scald. The contractor shall be required to provide a commissioning report indicating that all TMV's have been set and checked at 41°C at the outlet and provide signed and dated certificate in the O&M manual. The same commissioning certificate shall also indicate that each of the TMV' have been checked for anti-scald by isolating the cold water supply.

All valves must be installed within 1m of the outlet point(s) in an easily accessible location.

TMV mixing valves must never be connected to the mains water supply.

Please refer to Part 4: Equipment schedules for details on the Thermostatic Mixing Valves.

7.17 FITTINGS

Fittings shall be non-manipulative compression or integral solder ring type, above 50mm fittings are to be Hard Soldered (brazed). All installations shall comply with ACOP L8 for the prevention of legionella. Press fit or push fit type fittings are not permitted. No mixed metals are permitted on same system. Ensure/maintain earth path continuity where metallic and non-metallic pipes are present or are introduced within the same pipe run. The systems in compliance with ACOP L8 should ensure no dead legs within the systems.

7.18 PIPEWORK SUPPORT

The Contractor shall include for the provision of pipework support including installation of box brackets and unistrut brackets as required.

7.19 PIPEWORK & VALVE LABELLING

Appropriate colour identification bands and flow directional arrows shall be affixed to all insulated pipework. All valves within each Heating Plantroom shall be provided with an engraved plastic circular label numbered to correspond with a wall-mounted valve chart.

7.20 THERMAL INSULATION

All pipework and valves within each Plantroom, water tank room, in casings, ceiling voids or attic spaces shall be fully insulated with rigid mineral wool with foil covering as detailed in Part 3: Standard Specification and shall be fitted in accordance with the manufacturer's instructions. All valves greater than 25mm shall be insulated with wrap-around blankets secured by Velcro fittings. All insulation shall be fitted in accordance with the manufacturer's instructions. Additional taping every 2 meters shall be provided on the insulation within the Heating Plantrooms.

All insulation shall be Class A1, CFC and HCFC free with ozone depletion factor of zero.

Thermal conductivity shall not exceed 0.035 W/m/K and thickness shall be in accordance with the following:

Cold & Mains Water

Pipe Diameter	15mm	22mm	28mm	35mm	42mm	54mm	67mm	76mm
Insulation Thickness	20mm	25mm	25mm	40mm	40mm	40mm	40mm	40mm

Refer to Part 3 Specification Section 2350 Cold Water Supplies and Installations – Mineral Wool for more details.

Domestic Hot Water Flow & Return

Pipe Diameter	15mm	22mm	28mm	35mm	42mm	54mm	67mm	76mm
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Insulation Thickness	20mm	25mm	25mm	40mm	40mm	40mm	40mm	40mm
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Refer to Part 3 Specification Section 2290 Non-Domestic Hot Water Service – Mineral Wool for more details.

7.21 THERMOMETERS & PRESSURE GAUGES

Thermometers and pressure gauges shall be installed as indicated on the drawings and schematics as detailed in Part 3: Standard Specification.

7.22 PIPEWORK TESTING

The complete mains, cold and hot installations shall be fitted, jointed and pressure tested strictly in accordance with all relevant Irish and British Standards and Code of Practice and Part 3: Standard Specification.

All plumbing pipework shall be air tested to twice the working pressure for a period of two hours.

7.23 STERILISATION

All plumbing pipework and tanks shall be sterilised prior to handover as detailed in Part 3: Standard Specification and certification shall be provided within the Health & Safety File.

7.24 CONCEALING PIPEWORK

All plumbing pipework dropping from above ceiling to low level, if not concealed behind an IPS panel must be boxed in and painted to match the final wall colour. If there are any valves mounted on the vertical pipework access hatches must be provided on the boxing for regular access and maintenance.

7.25 PLUMBING SYSTEMS TESTING & COMMISSIONING

Prior to handover of the building the Contractor shall arrange to have mains water from a drinking tap sampled and tested for compliance inline with TGD 031.1 and S.I No. 122 of 2014 by an NSAI accredited test laboratory.

In addition to the above nine months after the system is in use, a water quality test must be taken again from a drinking tap and tested for compliance. Results of both tests sent to the employer's representative.

Failure of the sampled mains drinking water to meet the standards outlined in S.I No. 122 of 2014 will require remediation by the contractor before the issue of the Final Certificate on the Building Contract.

Care must be taken to ensure that the system remains clean during installation and in the event that the system is not demonstrated to contain clean water within the storage tank, the system must be drained and cleaned prior to handover.

The Health & Safety File information must include the following;

- Operation & Maintenance instructions
- As Installed Drawings
- Appropriate certification of the Mains Water Distribution System, including a record of the materials used and a copy of the EU approval of their use with mains water and drinking water systems
- A record of the commissioning and disinfection of the mains water distribution system including a record of the chemicals used and a copy of the EU approval for their use with mains and drinking water systems.
- The mains water system shall be fully flushed at the end of each holiday period by allowing the flow of the stated volume of the mains water system to run to drain. Instructions shall include the specification of a designated tap at the end of the distribution system and a calculated flushing period (based on the given flow-rate of the designated tap).
- All drinking water usage points (including water boilers) shall be opened to allow flushing of dead leg volumes. Instructions shall include an estimated standard flushing period for all outlets.

7.26 SYSTEM PARAMETERS

All new plumbing pipework shall be pressure tested and witnessed by the Engineer in accordance with Part 3: Standard Specification. Pressure test certificates will be required as part of the H&S Building manual.

Ballofix valves shall be provided on all new items of sanitaryware for local isolation of each item of equipment.

All pipework shall be fixed to the building fabric and supported in accordance with Part 3: Standard Specification.

As the system is operating at elevated temperatures and pressures special care shall be taken when working on the system.

Testing, Commissioning and setting to work shall be in accordance with Part 3: Standard Specification and the Commissioning Appendix at the rear of this specification and all relevant guidelines.

8 (54) NATURAL GAS INSTALLATION

8.1 GENERAL

The following information details the requirements for all Natural Gas installation works necessary for the completion of this Contract. All Natural Gas installation works must be carried out and certified by a Registered Gas Installer.

The Natural Gas installation shall be installed in accordance with the following;

- IS 820:2020 – Non-domestic gas installations
- IS 265:2000 – Installation of gas services pipes
- EN 1555:2010 - Plastic Piping Systems for the supply of gaseous fuels – Polyethylene (PE)
- IS 329 – Code of Practice for gas distribution mains

The Contractor shall supply, install, test and commission the new natural gas installation in accordance with this specification and detailed on the design drawings.

The system shall be a low pressure installation from the outlet of the Gas Networks Ireland (GNI) meter, with the maximum pressure drop not exceeding 1mbar from the meter to the last point within the building.

Before gas can be admitted to the premises by Gas Networks Ireland, the Registered Gas Installer / Contractor must complete a Declaration of Conformity in accordance with IS 813.

8.2 STRIPOUTS & NEW CONNECTIONS

To facilitate the proposed new extension, and the existing Plantroom has been fully installed and commissioned, the contractor shall alter the existing internal mild steel pipework within the 2010 extension Plantroom by disconnecting the gas supply to the existing gas fired boilers and extending a new gas supply to the new extension Plantroom. Where pipework passes through an enclosed space (ceiling void, fitted furniture or service riser), passive ventilation grilles shall be provided at high and low level.

Gas purge points shall be provided at the beginning & end of all sections of the system in the form of a valved branch sealed with a removable plug.

8.3 NATURAL GAS METER/RIG

There is an existing G100 meter serving the existing Plantroom and a science labs. It is not envisaged that this will require upgrading.

8.4 ABOVE GROUND INTERNAL GAS PIPEWORK & LABELING

The contractor shall be responsible for extending the new gas main to all items of plant in the Plantrooms requiring a gas supply.

Natural Gas pipework above ground in the Plantroom shall be fabricated from galvanized medium grade mild steel pipework manufactured to the requirements of IS EN 10255: 2004 with welded joints and shall be painted yellow (Yellow Ochre – 08 C 35) with identification banding at 3m intervals in accordance with Part 3: Standard Specification and labeled 'GAS'.

All valves within the Plantroom shall be provided with an engraved plastic circular label numbered to correspond with a wall-mounted valve chart. Gas purge points shall be provided at the beginning & end of all sections of the system in the form of a valved branch sealed with a removable plug. All purge points shall be clearly labelled on the 'as-installed' drawings and at the point of installation.

The BEMS shall monitor the gas consumption to the school via the GNI gas meter and chatter box.

8.5 INTERNAL GAS PIPEWORK VENTILATION

The contractor shall alter the existing internal mild steel gas pipework within the existing Plantroom to serve the new boilers as detailed on the drawings and in Part 3: Standard Specification. Where pipework passes through an enclosed space (ceiling void, fitted furniture or service riser), passive ventilation grilles shall be provided at high and low level.

Gas purge points shall be provided at the beginning & end of all sections of the system in the form of a valved branch sealed with a removable plug.

8.6 GAS METER

A Gas meter suitable for conveying Natural gas, shall be provided within the new Heating Plantrooms. The meter shall be supplied with volt free contacts for connection to the BEMS to read and record fuel energy usage. See Part 4: Equipment Schedule for performance specification.

8.7 PIPEWORK & VALVE LABELLING

Gas pipework shall be painted with two coats of Yellow Ochre (08 C 35) gloss paint in accordance with Part 3: Standard Specification and labeled 'gas' at regular intervals. All valves within the boilerhouse shall be provided with an engraved plastic circular label numbered to correspond with a wall-mounted valve chart. All purge points shall be clearly labelled on the as-installed drawings and at the point of installation.

8.8 INTERNAL GAS PIPEWORK VENTILATION

Where gas pipework passes through an enclosed space, passive ventilation grilles shall be provided at high and low level or within the ceiling void as required in line with IS 820:2019 Non-domestic gas installations.

8.9 GAS LEAK DETECTION

A gas leak detection system shall be supplied, installed, tested and commissioned in each Plantroom containing gas-fired equipment.

The new gas leak detection system shall comprise of a control panel c/w integral emergency stop activation, emergency slam shut solenoid valve fitted to the gas pipework at point of entry to the building, natural gas sensors at each item of gas-fired equipment with remote emergency knock off button. The gas leak detection system shall shut down the gas supply to the Plantroom / Building on detection of a leak or activation of the building fire alarm. See Part 4: Equipment Schedule for performance specification. The gas detection panel shall be provided with volt free contacts and an I/O interface unit for connection to the school fire alarm system.

The Contractor shall provide for full servicing of the gas detection system before handover and again before the end of the defects period.

8.10 PIPEWORK TESTING

The complete gas installation shall be fitted, jointed and pressure tested strictly in accordance with IS 820 and the Dublin Gas Company Regulations, ICP4: 1989, IM/16: Third Edition 1985 and all relevant Irish and British Standards and Code of Practice. A copy of the test record is to be made available to the gas company.

All gas lines shall be air tested to a pressure 1.5 times the Working Pressure or 1.5 times the pressure at which the slam shut valve is set. A soap test shall be carried out on each joint. The Contractor is advised that the Gas Company will require witnessing the tests on the pipework installation. It will be necessary for the Contractor to submit a copy of the Test Certificate to Gas Networks Ireland. All pressure testing is to be carried out in accordance with ICP4: 1989.

8.11 SYSTEM PARAMETERS

All new Natural Gas pipework shall be pressure tested and witnessed by the Engineer / Clerk of Works in accordance with Part 3: Standard Specification. Pressure test certificates will be required as part of the O&M manual.

A commissioning certificate shall also be required by the Registered Gas Installer and included as part of the O&M manual.

As the system is operating at elevated pressures special care shall be take when working on the system.

All pipework shall be fixed to the building fabric and supported in accordance with Part 3: Standard Specification.

Testing, Commissioning and setting to work shall be in accordance with Part 3: Standard Specification and the Commissioning Appendix at the rear of this specification and all relevant guidelines

9 (56) SPACE HEATING

9.1 GENERAL

The following information details the requirements for all heating distribution and emitter installation works necessary for the completion of this Contract.

9.1.1 Existing School Plantroom

The existing school heating shall be served by new central heating plant connected to a low loss flow and return header arrangement connected to the existing circuits where they have been cut back sufficiently to allow for the installation of new pipework and headers. The LPHW heating system shall be capable of operating at a flow temperature of 70°C and is designed to return at 65°C under full load.

System working temperatures and pressures:

Existing Heating Circuits: flow and return temperature	70°C / 65°C
System operating pressure	2.5 bar (approx.)
Room design temperature:	21 °C

The system has been designed to maintain space temperatures within the occupied spaces in the building when the external winter temperature is -3°C.

The Main Contractor shall be responsible for locating the existing North East circuit in the North East building and extending a new connection before the first tee off where it will connect to the existing 2010 extension heating circuit in the existing 2010 Extension Plantroom.

9.1.2 Extension Building

The central heating plant shall be connected to a low loss flow and return header arrangement. The LPHW heating system shall be capable of operating at a flow temperature of 55°C and is designed to return at 45°C under full load.

System working temperatures and pressures:

Constant Temperature UFH Circuit: flow and return temperature	55°C / 45°C
UFH pipework flow and return temperature	35°C / 30°C
System operating pressure	2.5 bar (approx.)
Room design temperature:	21 °C

The system has been designed to maintain space temperatures within the occupied spaces in the building when the external winter temperature is -3°C.

9.2 UNDERFLOOR HEATING

The installation of underfloor heating (UFH) system pipework shall include the supply and installation of the heating manifold, pump & valve arrangement, wiring centre and pipework and all associated components necessary for the efficient and safe operation of the underfloor heating system. Underfloor heating pipework and manifolds shall be installed as detailed on drawings and in Part 4: Equipment Schedule. The specialist supplier shall provide final installation drawings for approval before commencement.

All zones shall be complete with intelligent controller to provide time and temperature control. The zones shall also have the ability to be enabled on a time schedule through the BMS. Manifold location shall be agreed with the engineer and architects prior to construction.

Mechanical Subcontractor & their specialist UFH subcontractor to include for the complete supply & install of the UFH system.

System to include:

1. Stainless Steel UFH Manifolds (Stainless Steel Manifolds up to 12-way)
2. UFH Multilayer pipework
3. Edge Insulation
4. Jet Rail for laying of UFH pipework
5. UFH Clips for securing rail and pipe
6. Oventrop 230v Actuators for manifolds
7. Room Thermostats
8. Wiring Centre

Pipework shall be 16mm PERT/AL/PERT to DIN 4726 and DIN 16833/84 and installed using pipe clip rails and tacker clips to ensure even spacing throughout the new extension with the floor screed to be installed by the main contractor.

The contractor shall ensure the UFH pipework is carefully bent to avoid kinking. If any kinks occur the contractor shall remove the affected circuit in its entirety and replace with new pipework, without additional cost.

The system must be designed to accommodate multiple heating zones, with each zone having a dedicated manifold and the capability to control temperature individually. The pipe layout shall be designed to ensure an even distribution of heat, with no areas left without heating or subject to uneven temperature distribution. The maximum pipe spacing shall be 200mm. The heating system shall incorporate both flow and return pipes, ensuring a balanced system with proper circulation of the heating medium.

All underfloor heating circuits shall be fully hydraulically pressure tested to 6 bar for a minimum period of 2 hours immediately before the floor screed is poured. The system should remain under pressure whilst the floor is laid so that if any damage occurs to the pipe, the laying of the floor can be stopped and the damage repaired immediately.

The pressure testing should be witnessed

9.3 PIPEWORK

LPHW heating pipework shall be medium grade black mild steel tube to IS EN 10255: 2004 Medium as detailed in Part 3: Standard Specification except where noted on the drawings. Pipework shall be installed to form a two-pipe flow and return heating system and shall generally be routed via ceiling voids / service ducts as detailed on the design drawings.

All pipework shall be fully painted (red oxide) upon completion of installation.

All pipework up to 50mm shall have screwed joints. Pipework above 50mm shall be welded and pipework in the Plantroom Areas shall be flanged.

The underfloor heating pipes shall be made of cross-linked polyethylene (PE-X) or multi-layered composite pipe (PE-RT/AL/PE-RT), or a suitable equivalent that meets the performance requirements outlined in part 4 specification. The pipework shall be sized in accordance with the system's design requirements, typically 16mm or 18mm diameter, and shall be capable of withstanding pressures up to 6 bar and temperatures up to 80°C. The pipework must conform to IS EN ISO 10508:2015 or equivalent for PE-X pipes, or IS EN 15875:2010 for multilayer composite pipes.

9.4 PIPEWORK TESTING

The complete LPHW heating installations shall be fitted, jointed and pressure tested strictly in accordance with all relevant Irish and British Standards and Code of Practice and Part 3: Standard Specification.

All LPHW heating pipework shall be air tested to twice the working pressure for a period of two hours.

9.5 PIPEWORK SUPPORTS

The Contractor shall include for the provision of pipework support including installation of box brackets and unistrut brackets as required.

9.6 THERMAL INSULATION

All space heating distribution pipework shall be insulated in rigid mineral wool insulation with foil covering as detailed in Part 3: Standard Specification. All insulation shall be fitted in accordance with the manufacturer's instructions. All insulation shall be Class A1, CFC and HCFC free with o-zone depletion factor of zero.

Thermal conductivity shall not exceed 0.035 Wm²K and thickness shall be in accordance with the following:

Pipe Diameter	15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm
Insulation Thickness	20mm	25mm	25mm	40mm	40mm	40mm	40mm	40mm

Refer to Part 3: Standard Specification Section 2310 Non-Domestic Heating Installations – Mineral Wool for more details.

9.7 INSULATION - EXTERNAL

All exposed pipework and valves shall be insulated with mineral fibre preformed split tube type insulation secured with tape and fully wrapped with PIB tape to form a moisture proof barrier. Insulation shall also be covered in hammer finish aluminium cladding to provide protection for moisture barrier against wildlife and footfall. All insulation shall be Class A1, CFC and HCFC free with o-zone depletion factor of zero.

Pipe Diameter	15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm	100 & 125mm
Insulation Thickness	20mm	25mm	25mm	40mm	40mm	40mm	40mm	40mm	50mm

Thermal conductivity shall not exceed 0.035 W/mK and thickness shall be in accordance with the following:

9.8 PIPEWORK & VALVE LABELLING

Appropriate colour identification bands and flow directional arrows shall be affixed to all insulated pipework as described in the Part 3 Standard Specification and inline with BS 1710: 2014.

9.9 VALVES

Isolating Valves, Double Regulating Valves (DRV), Commissioning Sets and 2-port solenoid zone control valves shall be installed as indicated on the drawings and as noted in Part 3: Standard Specification. Double Regulating Valves / Commissioning Sets shall be selected for the circuit operating flow rates and pressures. When selecting valves the contractor must liaise with their valve specialist to ensure the correct valves are selected and suitable for each application. The LPHW heating distribution system shall be provided with adequate drain cocks (as per Part 3: Standard Specification) to facilitate sectional maintenance and repair works.

2-port control valves shall be provided with Kv values suitable to the proposed flow, particularly in the case of 15mm & 20 mm valves.

9.10 EXPANSION BELLOWS & ANCHOR POINTS

The Contractor shall allow for expansion bellows, anchor points and guides on all straight pipework runs over 25m if a natural offset in the pipework does not occur.

9.11 AIR VENTING

Air vents shall be provided as necessary and be installed at the highest points of pipework installation. Each automatic air vent shall be controlled by a lock-shield valve and air release pipes shall run to discharge at the nearest suitable visible point outside.

9.12 DRAIN COCKS

The pipework shall be installed to a gradient to allow effective draining down when required. All low points shall be fitted with drain cocks. The contractor shall indicate all low and high points and clearly indicate these on their installation drawings.

9.13 2-PORT CONTROL VALVES

Temperature control to each teaching space and temperature controlled environments shall be via local 2-port motorised control valves and extra low voltage digital thermostats with a lockable range of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and shall all be linked on a common bus system to the BEMS. The power and control shall be derived from the BEMS panel. Each zone shall have a separate time schedule and boost facility.

9.14 ROOM TEMPERATURE STATS

Room Temperature Stats shall be of the digital type with an LCD display. The temperature stats shall provide the following functions:

1. Clearly display the room temperature.
2. Clearly display the room set point temperature
3. Allow the user to easily adjust the set point temperature
4. Operate on a 24 V power supply (battery stats are not acceptable)
5. Provide a 24 V power control to a two port motorized valve

Clear Instructions outlining the operation of the local heating controls in teaching spaces should be provided at each controller.

Specification of room temperature stats are outlined in Part 4: Equipment Schedules.

9.15 ZONE CONTROL

The UFH system shall be fitted with a programmable room thermostat for each heating zone. Each zone should have an individual actuator connected to the manifold to regulate the flow of the heating.

9.16 PIPEWORK FINISHES

All exposed plumbing pipework should be painted to match the final wall colour. See Part 3: Standard Clauses for details.

Where pipework drops are surface-mounted, they must be insulated and enclosed in plasterboard casing finished and painted to match adjacent walls. If there are any valves mounted on the vertical pipework, access hatches must be provided on the casing for regular access and maintenance.

9.17 PAINTING

All factory-finished items shall be touched up if scratched or chipped. Badly damaged items shall be replaced without charge to the Client. The Contractor shall include for protecting all works to avoid damage by other trades.

9.18 SYSTEM REQUIREMENTS

All new pipework shall be routed above ceilings / service ducts and dropping to low level within the space and shall be co-ordinated with all other mechanical & electrical services.

Prior to any filling and venting of the new LPHW systems the Contractor shall be responsible for pressure testing all new pipework and shall give sufficient notice to the Consulting Engineer / ER to allow pressure testing of pipework to be witnessed. Signed and dated pressure testing certificates will be required in the H&S Building manual.

The Contractor shall be fully responsible for flushing, filling and venting the new heating installation in line with Part 3: Standard Specification.

The Contractor shall be responsible for completely hydraulically water balancing the new LPHW heating system to water flowrates advised by the Consulting Engineer. All certificates shall be signed and dated by the contractor and witnessed by the Consulting Engineer / ER (signed and dated) prior to insertion into the H&S Building manual.

The Contractor shall be responsible for treating the new heating system with corrosion inhibitor inline with the manufacturer's recommendations.

As the system is operating at elevated temperatures and pressures special care shall be taken when working on the system.

The contractor shall ensure that straight lengths of pipework are provided at key flow measurement points. Flow measurement points are to be provided a minimum equivalent of 10 pipe diameters upstream of any bends or fittings etc.

10 (57) VENTILATION INSTALLATION

10.1 GENERAL

The following information details the requirements for all supply, extract and passive ventilation works necessary for the completion of this Contract. Installation and commissioning of the ventilation systems shall be carried out in accordance with CIBSE commissioning codes.

All submittals shall be in compliance with Table 6 of Part L of the Building Regulations Part L, Conservation of Fuel and Energy – Buildings other than Dwellings, 2021. All fans shall be selected such that Maximum Specific Fan Powers as listed in Table 6 are not exceeded. Contractors shall state the specific fan powers as part of their product submittals to the consultant engineer.

10.2 GENERAL DUCTWORK

In general, all mechanical ventilation ductwork shall be rigid galvanized sheet metal to BESA DW144 and shall be installed in accordance with the Mechanical Specification Part 3: Standard Clauses. Ductwork shall generally be routed within ceiling voids as detailed on the drawings.

All ductwork shall be examined by the engineer prior to thermal insulation being applied to ensure that there is no physical damage covered.

Smaller local ventilation ductwork shall be rigid, spiral type as detailed in Part 3: Standard Specification except where otherwise indicated. Ductwork shall generally be routed within ceiling voids as detailed on the drawings.

The arrangement and sizing of all internal and external ductwork installations indicated on the drawings shall be agreed with the Engineers on site.

Duct sizes shall be taken to mean the clear internal dimension or diameter as relevant to the particular duct specification.

All engineering, design, materials of construction, fabrication, inspection, testing, commissioning, installation and supervision shall conform to the latest edition of the following standards and codes of practice:

- B&ES DW/144: Specification for sheet metal ductwork - low, medium and high pressure/velocity systems
- B&ES DW/143: A practical guide to ductwork leakage testing
- B&ES DW/151: Specification for plastics ductwork
- B&ES TR/17: Guide to good practice, cleanliness of ventilation systems
- B&ES DW/TM2: Internal cleanliness of new ductwork installations

The Contractor shall be responsible for taking all final measurements on site and as necessary for the fabrication and erection of the ductwork. Where site dimensions cannot be obtained in advance of fabrication drawing preparation, suitable provision shall be made to accommodate any discrepancies that may arise between site dimensions and drawings. Duct lengths constructional details shall achieve maximum economy of manufacture and erection, subject to compliance with construction standards and access into buildings.

All ductwork installations when erected shall be rigid and shall be free from sway, drumming or movement. Local stiffening shall be incorporated to provide rigid mountings for instruments and controls.

Ductwork passing through roofs or external walls shall be provided with weathering aprons or other weatherproof fixing.

Perforated rivets shall not be used in the manufacture or erection of ductwork. The use of self-tapping screws shall be limited to the completion of site joints in extremely difficult locations.

Access openings and doors for inspection and cleaning shall be provided in accordance with DW/144, TR/17 and DW/171, as applicable and where indicated on the drawings.

Connections to builder's work and openings shall be as detailed in DW/144 and as detailed on the drawings.

Test holes formed for system balancing and commissioning shall be fitted with suitably sized easily removable rubber or neoprene sealing plugs.

All ductwork shall be thoroughly degreased and cleaned after fabrication and the ends of each length shall be sealed and remain so until erection. All openings in ductwork systems shall remain sealed during construction.

Storage of ductwork on site shall be kept to a minimum.

The Contractor shall ensure that metallic ductwork systems are earthed by the electrical contractor prior to insulation

10.3 FLEXIBLE DUCTWORK

Flexible ducting shall be used to connect ductwork to each grille, fan and any other ventilation unit. Flexible ducting shall be of the acoustic type, SONADEC 25 AA3 (or equal and approved) as supplied by 'Ventac' or equal and approved. Lengths of flexible ducting to grilles shall not exceed 300mm.

10.4 DUCTWORK THERMAL INSULATION & LABELING

All intake, supply, return and exhaust ductwork from MHRV units shall be fully insulated with 50mm duct wrap with foil backing to maintain temperatures and efficiencies and prevent condensation. Where ductwork is exposed externally or in internal areas where there is a risk of mechanical or weather damage to the insulation the ductwork shall be fully insulated and aluminium hammer clad to provide mechanical protection in accordance with the Mechanical Specification Part 3: Standard Clauses. All thermal insulation shall have an ozone depletion factor and global warming potential of zero as per Part 3: Standard Clauses.

Appropriate colour identification bands and flow directional arrows shall be affixed to all insulated and un-insulated mechanical ventilation ductwork.

10.5 CONCEALED MECHANICAL HEAT RECOVERY VENTILATORS

Mechanical supply & extract ventilation shall be provided to all Classroom areas as indicated on the design drawings by way of Mechanical Heat Recovery Ventilator Units (MHRV's). The MHRV's shall extract warm stale air from the space it is serving and provide a ducted tempered fresh air supply to that space via ceiling mounted swirl diffusers to provide clean fresh air for occupancy.

The MHRV units shall be manufactured from galvanised sheet steel and shall comprise of a highly efficient counter flow plate heat exchanger with thermal efficiencies in excess of 80%, automatic summer by-pass modulating damper, low energy / low noise level ErP Compliant DC supply & extract fans/motors, G3 panel filters on the supply & extract with front and rear duct connections.

The ventilation unit shall automatically vary the ventilation rate in the space dependent upon the signals received from the interconnected sensors and user interface (where provided). When signals are received, the unit shall vary its fan speeds proportionally until the desired set points are met.

The unit shall have the facility to commission the supply and extract fans individually via inbuilt maximum, minimum and offset speed adjustments. Each fan shall have variable speed control drives.

The heat recovery units shall have a maximum noise output of 35dB(A) and maximum fan speed.

The unit shall incorporate a high efficiency aluminum counter flow plate heat exchanger matrix fitted with a segmented 100% bypass facility and actuator operating under automatic control.

All elements of the unit shall be protected from airborne contamination by high capacity pleated G4 panel filters (supply and extract). **Two spare filters shall be provided for post construction phase for client use.**

The unit shall be fitted with ErP 2016 rated, low energy, high efficiency IP54 EC motorised fans

providing low specific fan powers and stepless speed control, without tonal noise generation.

The unit shall be constructed with removable panels, accessible from below, allowing maintenance access with minimal service space clearance required.

The removable panels shall provide access to the following:

- Supply and extract fan.
- Supply and extract filter.
- Condensate tray.
- All control adjustments

Supply and extract fans, high efficiency counter flow plate heat exchanger matrix, supply and extract filters, full 100% automatic heat exchanger bypass, heating coil (as selected) & condensate drip tray, a condensate pump is installed in the unit and has an alarm function.

The unit integrated control system provides the facility for operational efficiency and energy saving by allowing a comprehensive range of unitary control functions and / or full BMS integration (by others) via standard BACnet (MS/TP).

Each MHRV unit shall be provided with its own dedicated wall controller with VFC's for enable / fault from the BEMS and capable of providing a visual fault alarm locally in the space. Final location of wall controller as per Architects Room Data Sheets.

10.6 MHRV UNIT CONTROLS

All MHRV units shall be locally powered from an electrical distribution board and enabled within the space it serves via PIR presence detector.

Each MHRV unit shall be provided with a wall mounted controller and a duct mounted 'plug & play' CO2 sensor which shall both be powered directly from the MHRV unit. Using Demand Control ventilation principles, the MHRV unit shall automatically vary the ventilation flow rate via DC motors as it receives a signal from the CO2 sensor mounted in the return air duct to the MHRV unit. When a signal is received, the fans shall vary their speed proportionally in an energy efficient manner. Precise control of the MHRV system, driven by the ventilation requirements of the room at any one time, means that the system is only running to the level required, using energy when it is needed.

Each MHRV unit shall be provided with the manufacturers ON/OFF Adapter or similar facility to allow the MHRV units to disable upon activation of the Fire Alarm / BMS shutdown.

10.7 INLINE EXTRACT FANS

Local general extract fans shall be the low noise in-line acoustic box type to reduce noise levels with ErP Compliant EC motors as indicated on the design drawings and detailed in Part 3: Standard Specification and Part 4: Equipment Schedules.

Adjustable speed controllers shall be provided with each inline extract fan and shall be mounted above the ceiling to assist with setting up the correct air volumes and commissioning. All Fans shall be provided with integral run on timers adjustable from 2-30 minutes. Inline extract fans shall have a max Specific Fan Power (SFP) of 0.5W/l/s in accordance with Building Regulations Part L: 2022.

All local extract ventilation systems shall be provided with a spring return back draught shutter on the exhaust ductwork as indicated on the design drawings.

Where mechanical ventilation is provided to a noise sensitive habitable spaces, inline duct attenuators shall be provided on the room side of the fan to reduce fan noise transmission back to the space. The contractor shall ensure that when selecting fans to all spaces, noise levels from mechanical ventilation shall not exceed a background noise level of 35 dB(A) in Teaching spaces and 45 dB(A) in Circulation spaces.

10.8 EXTRACT FAN CONTROLS

All inline extract fans shall be locally powered from an electrical distribution board and enabled locally via the PIR presence detector. All general extract fans shall be provided with a speed controller mounted above the ceiling for set up of air volumes at commissioning stage only.

10.9 DCC / IDF ROOM VENTILATION

Mechanical ventilation shall be provided to the DCC / IDF Rooms as this is where the electrical Comms cabinet shall be located. Mechanical ventilation shall provide a minimum of 10 air changes an hour from the space to dissipate the heat buildup and ducted to the adjacent corridor to be used as useful heat. The fan shall be controlled via a local wall mounted thermostwitch set at 25°C to enable the fan at this temperature.

10.10 DIFFUSERS / GRILLES

Supply diffusers & Extract grilles shall be installed as indicated on the design drawings and detailed in Part 3: Standard Specification and Part 4: Equipment Schedule. For purposes of tendering, diffusers and grilles shall be provided in a powder-coated white finish. During the Technical Submittal process the Contractor shall check with the ER exact colour of ALL diffusers and grilles prior to ordering.

Contractor shall allow for all diffusers & grilles to be positioned within a one meter radius of that indicated on the design drawings.

Please refer to the Grille Schedule in the Part 4: Equipment Schedules for air volumes, grille types and performance specification.

10.11 VOLUME CONTROL DAMPERS

Duct mounted volume control dampers shall be provided as indicated on the design drawings to facilitate air balancing. Single blade dampers shall be provided on circular ductwork up to 315mm dia. Please refer to part 3: Standard Specification for details.

10.12 BACK DRAUGHT DAMPERS

Non-return back-draught dampers shall be provide on all mechanical ventilation ductwork up to a diameter of 150mm. Motorized shut-off dampers which shall operate to close when the fan is not in use shall be provided on all larger ducts above 150mm. For the mechanical extract ventilation systems greater than 150mm the Contractor shall allow for a suitable electronic controller that is compatible with the PIR, Fan, Speed Controller and Motorized damper. It is important that this controller can be programmed to ensure the motorized damper is fully opened before the extract fan is enabled.

10.13 FIRE DAMPERS

Duct mounted fire dampers (CE Marked) shall be provided on any mechanical ventilation duct that passes through a fire rated compartment or fire barrier. All Fire Dampers shall be test proven for the specific application to achieve the necessary fire resistance period (bi-directionally) and smoke leakage in accordance with IS EN 1366-2:2015 and classified to IS EN 13501-3:2005 +A1:2009. The fire damper shall be installed in strict accordance with the manufacturer's instructions for the type of construction in which it will be fixed (e.g. masonry, plasterboard, etc).

When installing multiple dampers in close proximity, it shall be ensured that the separation distances outlined in BS EN 1366-2:2015 are adhered to (e.g. distances between dampers are not less than 200 mm and the distance between dampers and other obstructions is not less than 75mm). Relaxations in this are only acceptable where test evidence is available.

Fire dampers shall be supported independently of the ductwork and mechanically fixed to robust fire resistant supporting structure. DW 145 (Guide to good practice for the Installation of Fire and Smoke Dampers) and ASFP guides shall be adopted for further requirements relating to the installation requirements including builder's work and the certification process. Thermally actuated fire dampers will be provided in all ductwork passing through any fire rated construction (E Classified) with the exception of escape routes.

An access hatch shall be provided on the ductwork each side of the fire damper for visual inspection and reset. All fire dampers shall be readily accessible and co-ordinated with other ceiling services.

Every effort has been made to incorporate a fire damper on ventilation ducts passing through fire rated compartments, but the contractor shall satisfy himself that he has included all costs for fire dampers based on the Fire Report and Fire Compartmentation drawings. Please refer to Specification Part 3: Standard Specification for details on Fire Dampers and Part 4: Equipment Schedules for Performance Specification.

10.14 AIR TRANSFER GRILLES

Wall Air transfer ductwork and grilles shall be provided as indicated on the design drawings. Grilles shall allow the transfer of make-up air from the corridor to the mechanically ventilated space when a fan is in operation.

10.15 EXTERNAL LOUVRES

External weather louvres shall be installed as indicated on the design drawings and detailed in Part 4: Equipment Schedule. External louvres shall be provided with an insect mesh and backdraught dampers. For purposes of tendering external louvres shall be supplied in a brushed anodised aluminum finish unless otherwise indicated. During the Technical Submittal process the Contractor shall check with the ER exact colour of ALL external louvers prior to ordering.

10.16 ROOF COWLS

External roof cowls shall be installed as indicated on the design drawings and detailed in Part 3: Standard Specification and Part 4: Equipment Schedule. All roof cowls shall be provided with a bird guard. Contractor to check with the ER exact colour of ALL roof cowls prior to ordering.

Roof terminations shall be installed with a polycarbonate mushroom cowl arrangement with integral insect mesh to be mounted on a roof upstand. Soaker sheets complete with integral upstands shall be provided on composite panel roofs from the ridge location.

10.17 MAKE-UP AIR

Make-up air shall generally be provided by undercutting doors by 10mm where possible within the requirements of the Fire Certificate. Where there are spaces with large extract air volumes transfer grilles shall be provided on walls or doors as required for make-up air.

10.18 STORE ROOM VENTILATION

Each store shall be provided with passive ventilation to outside as indicated on the design drawings.

10.19 CO₂ MONITORING

CO₂ monitors shall be installed in all teaching spaces and located on the teaching wall facing the body of the classroom. The CO₂ monitors shall consist of a CO₂ sensor and be provided with an LED display. The display colour shall be capable of changing from Green to Amber to Red to indicate the CO₂ levels. The CO₂ sensor shall be powered locally and not connected to the BMS system. Please refer to Part 4: Equipment Schedules for technical performance specification.

10.20 SYSTEM PARAMETERS

The contractor shall be responsible for calculating the final working resistance within each of the ducting systems and ensuring that the supplied equipment can achieve the duties at the relevant noise levels in each space based on their own co-ordinated working drawings.

Testing, Commissioning and setting to work shall be in accordance with the Commissioning Appendix at the rear of this specification and Part 3: Standard Specification.

Workmanship, Installation and identification all be in accordance with the Mechanical Specification Part 3: Standard Clauses.

The Contractor shall be responsible for completely air balancing the entire new ventilation systems to air volumes noted in this specification and on the design drawings. All certificates shall be signed and dated by the contractor and witnessed by the Consulting Engineer/ ER (signed and dated) prior to insertion into the O&M's / Health & Safety File.

11 (57) VRF AIR CONDITIONING SYSTEM

11.1 GENERAL

The following information details the requirements for the VRF Air-Conditioning (A/C) works necessary for the completion of this Contract to maintain internal space conditions as required. Installation, testing and commissioning of each VRF A/C system shall be carried out in accordance with CIBSE commissioning codes and the manufacturers recommendations.

Noise level shall not be exceed in each space when the A/C units are operating on Medium Speed.

11.2 SYSTEM DESCRIPTION

The A/C systems shall be a High Efficiency Heat Recovery Variable Refrigerant Flow (VRF) type installation which shall allow simultaneous heating and cooling to the space. VRF air-conditioning equipment shall be provided to maintain internal space temperatures as required and the unit shall be the heat pump type capable of simultaneous space heating and cooling. The A/C installations shall utilise a low GWP R32 refrigerant or better and shall provide accurate load matching to the internal space requirements.

The internal A/C heat pump unit shall be the above ceiling ducted re-circulating type. The indoor A/C heat pump unit shall be piped to a heat recovery BC Controller with the A/C unit independently providing heating or cooling to the space.

The VRF indoor A/C system shall be piped to a VRF air cooled condenser unit located externally on the roof as shown on the drawings, via the BC Controller using only 2 refrigerant pipes between the outdoor VRF condenser unit and the BC Controllers and between the indoor A/C heat pump unit.

The VRF A/C system shall have the following features;

- 2 pipe heat recovery simultaneous heating and/or cooling system
- Reduced refrigerant charge
- Multiple refrigerant evaporating temperature settings
- Continuous heating during defrost
- High Performance Heating or COP priority modes
- R32 low GWP refrigerant

The VRF condenser unit shall have multiple selectable sound output modes. Capacity and sound power of the outdoor unit module shall be capable of being reduced in four increments by making connection on the outdoor unit PCB board and setting dip switches.

The complete Air conditioning installation shall be on the specialist A/C manufacturers M-Net network or similar and controlled via a centralized controller. The specialist A/C contractor shall install on M-Net network infrastructure and all associated interconnecting cabling bespoke to their installed system. The electrical contractor shall provide all main electrical containment to carry the specialists M-Net network cabling and shall also provide a power supply to the BC Controller, and indoor A/C heat pump and associated external VRF Condenser unit as required. The specialist A/C sub-contractor shall also provide all interconnecting refrigerant piping.

The Installation and commissioning must be carried out by an Approved Refrigeration Installer and the systems must be installed strictly in accordance with the manufacturer's recommendations.

Refer to Part 3: Standard Specification and Part 4: Equipment Schedule for more details.

11.3 REFRIGERANT CHARGING

Refrigerant (R32) charge weight shall be calculated, to the actual installed length of pipework in accordance with the manufacturers recommendations. The charging shall be carried out using appropriate charging scales. Once completed the F-Gas label on each outdoor VRF condenser unit should be complete to indicate factory charge, additional charge and total charge.

11.4 REFRIGERANT PIPEWORK & INSULATION

All pipework shall be refrigerant quality soft / medium drawn copper tubing to EN 14276 and complete with appropriate headers and joints and shall have brazed joints. Refrigerant pipework must be installed in accordance with EN 378 and strictly in accordance with the manufacturer's recommendations. Longest possible lengths of copper pipe shall be utilised to minimise joints on site. Oxygen Free Nitrogen (OFN) tools shall be used at all times in the system during brazing. Refrigerant pipework shall run on galvanised cable tray and supported at a minimum of 1.5 meter centres as per manufacturers recommendations and each pipework system shall be labelled with ID number (Condenser Unit reference) at 3 meter intervals.

Pipework Insulation shall be as required by the manufacturer, but it shall be in closed cell nitrile rubber preformed flexible sections with vapour barrier, and an O-Zone depletion factor of zero, a Global Warming Potential of Zero and with a Fire Performance of Class A1 as detailed in Part 3: Standard Specification. The wall thickness of the pipework insulation shall have a minimum thermal conductivity of 0.037w/mK.

11.5 DRAINAGE PIPEWORK

uPVC condensate drainage pipework shall be provided from the indoor VRF A/C heat pump unit above ceiling and piped to the nearest soil stack or vent pipe complete with self-sealing HEPVO waste valve. Rodding eyes shall be provided at all changes of direction.

11.6 PIPEWORK SUPPORT

Support all refrigerant pipework, condensate drainage pipework and controls cabling throughout their length using cable tray, firmly fixed to the building fabric.

11.7 PIPEWORK SUPPORT EXTERNALLY

All external refrigerant pipework and cabling shall be installed on galvanised cable tray as per manufacturers recommendations to safely support the refrigerant pipework and cabling. Inverted cable tray shall be provided over all external refrigerant pipework and cabling to provide environmental and mechanical protection.

11.8 PIPEWORK & VALVE LABELLING

Appropriate colour identification bands and flow directional arrows shall be affixed to all insulated refrigerant pipework.

11.9 A/C CONTROLS

A proprietary web based Centralised A/C Controller with a 10.4" touch screen shall be provided which shall be capable of controlling and monitoring the complete A/C installation within the building. The specialists centralized controller should be provided with a BACnet interface for connection to the Building Energy Management System (BEMS). The contractor shall allow for the purchase of a BACnet Pin Code license from the specialist A/C manufacturer, if required, to allow connection to the BEMS BACnet system.

The VRF A/C system including BC Controller, indoor heat pump unit and external VRF Condenser unit shall all be connected to the specialists M-Net network infrastructure or similar, which in turn shall be connected to a centralized controller and expander unit. The centralized controller shall then be connected to the BEMS where it can extract information and log faults and raise an alarm on the BEMS etc. In the event of a fault on the A/C system an alarm shall appear on the centralized controller and a common lamp shall illuminate on the face of the BEMS control panel to indicate a fault.

The electrical contractor shall provide all main electrical containment to carry the specialists M-Net network cabling and shall also provide a power supply to the BC Controller, and indoor A/C heat pump and associated external VRF Condenser unit as required. The specialist A/C sub-contractor shall also provide all interconnecting refrigerant piping.

In addition to the above, a local dedicated back lit standard wired wall controller shall be provided with an A/C heat pump, which shall be powered from the indoor unit and shall provide end user functionality such as on/off, mode (heating/cooling), temperature setpoint adjustment, fan speed and night setback etc. Wall controller is indicatively indicated on the design drawings but the final location of the wall controller shall be in the position as agreed on site or indicated on the Architects Room Data Sheets.

11.10 REFRIGERANT LEAK DETECTION & AUTOMATIC PUMP DOWN

Inline with EN378 two safety measurers are required for the R32 refrigerant gas Air Conditioning systems, based on design layouts and calculations. Refrigerant leak detection with alarm and Automatic refrigerant pump down controls system are required.

The leak detection system shall comprise of a semi-conductor type sensor that shall identify an unlikely critical concentration of refrigerant leak from the Air Conditioning systems and shall be capable of creating an audible and visual alarm in each space containing an Air Conditioning unit via the detector. The semi-conductor leak detector shall be flush mounted on a wall at low level, at a minimum of 150mm above floor level. All leak detectors shall be linked to the A/C specialists proprietary Central Digital Leak Detection Alarm panel mounted in the Reception Office. The panel shall have an audible and visual display with LED indicators to indicate status of room and alarm conditions and shall be linked on the common A/C M-NET network and shall be capable of providing a common alarm on the BEMS.

In addition to the above, the Contractor shall supply, install, test and commission an automatic pump down control system(s) comprising automatic control panel and actuated isolation ball valves. The ball valves shall be located on the liquid/gas refrigerant pipework between each external condenser unit and its associated BC Controller. In the event of a leak detected from the A/C system the control panel shall automatically pump the refrigerant down in the system. Multiple Automatic Control panels may be required based on the quantity of indoor and outdoor A/C units proposed as part of the contractors technical submittals and proposed A/C specialist, but no more than 2no. automatic control panels should be required. The contractor shall ensure that the leak detection and automatic pump down systems shall incorporate all elements required for safety and environmental protection. The automatic pump down control panel shall be linked on the common A/C M-NET network and shall be capable of providing a common alarm on the BEMS.

11.11 WARRANTY

A 7 year warranty shall be provided by the A/C specialist installer via a Business Solution Partner.

12 (57) COMPRESSED AIR INSTALLATION

12.1 GENERAL

The compressed air installation shall be used to power dental tools and equipment. The entire compressed air installation shall be supplied, installed and commissioned by a specialist medical gas pipework installer as HPI or BOC. All compressed air lines shall be degreased copper. The entire compressed air installation shall be installed and commissioned in accordance with HTM 02-01 Medical Gas Pipeline Systems.

12.2 COMPRESSOR

The contractor shall supply and install the compressor and commissioning and final connections must be made by the medical gas line installer and be in accordance with HTM 02-01 Medical Gas Pipeline Systems.

- Voltage 230 (1~) V 230 (1~) V 230 (1~) V
- Frequency 50 / 60 Hz 50 / 60 Hz 50 / 60 Hz
- Electrical power 1,30 / 1,50 kW 1,50 / 1,70 kW 1,5 / 1,7 kW
- Current consumption 7,6 / 6,9 A 7,7 / 7,0 A 7,7 / 7,0 A
- Delivery (5 bar) 124 / 140 l/min 110 / 126 l/min 110 / 126 l/min
- Pressure range 6 - 7,8 bar 6 - 7,8 bar 6 - 7,8 bar
- Dimensions 65 x 48 x 41 cm 65 x 49 x 47 cm 84 x 63 x 60 cm
- Noise level at 5 bar 68 dBA 68 dBA 59 / 62 dBA
- Noise level with cabinet 51/52 dBA 51 dBA -
- Tank volume 20 l 20 l 20 l

12.3 PIPEWORK, FITTING AND VALVES

Shall be degreased copper as indicated on the relevant drawings, installed by the medical gas line installer and be in accordance with HTM 02-01 Medical Gas Pipeline Systems.

12.4 DRAIN POINTS

Drain Points shall be supplied and installed by the medical gas line installer in accordance with their recommendations and in accordance with HTM 02-01 Medical Gas Pipeline Systems.

12.5 COMPRESSED AIR OUTLETS

Each compressed air line outlet shall be installed by the medical gas line installer and be in accordance with HTM 02-01 Medical Gas Pipeline Systems and finished flush with the floor screed and c/w a ballfix valve.

12.6 IDENTIFICATIONS

Identification required in accordance with HTM 02-01 Medical Gas Pipeline Systems.

12.7 PROTECTION

Protection required in accordance with HTM 02-01 Medical Gas Pipeline Systems.

13 (57) VACUUM DELIVERY SYSTEMS

13.1 GENERAL

The Vacuum / suction installation shall be used to remove waste spittle and fluid from the dental surgeries. The entire Vacuum / Suction pipework installation shall be supplied and installed by the contractor and commissioned by a specialist medical gas pipework installer. All suction lines shall be Grey MUPVC c/w push fit joints and fittings. All suction lines shall be independent from each other from their source to the plant room where they connect to a manifold and then in turn connect to the main Vacuum / Suction unit. The entire Vacuum / Suction installation shall be installed and commissioned in accordance with HTM 02-01 Medical Gas Pipeline Systems. The Vacuum / Suction lines should comprise materials resistant to attack from substances carried and be so constructed as to withstand a negative pressure of 25 kPa. Where non-metallic pipework pass through fire compartment walls/barriers they should be suitably sleeved with an intumescent fire collar.

13.2 EQUIPMENT SCHEDULE

The main Vacuum suction unit shall be supplied and installed by the contractor but final connections must be made by the medical gas line installer supplying installing the suction / Vacuum pipework installation and be in accordance with HTM 02-01 Medical Gas Pipeline Systems.

14 (58) BUILDING ENERGY MANAGEMENT SYSTEM

14.1 GENERAL

The following information details the requirements for all controls installation works necessary for the completion of this Contract including boilerhouse and field controls.

A Building Energy Management Systems shall be supplied, installed, tested and commissioned as part of this contract in each main school building Heating Plantroom.

All time and temperature settings shall be agreed with the Consulting Engineer during commissioning. The contractor shall allow for 2 no. demonstrations of the controls system to the client.

The contractor shall allow for a full service and checking of the system by the BMS specialist at the end of the defects liability period along with seasonal commissioning during the first year of operation.

14.2 DESCRIPTION OF WORKS

The BEMS systems shall be an open protocol computer based systems that monitors and initiates stop and start sequences for all the mechanical plant and equipment. The systems shall permit the end user to login to the system accessing plant time scheduling and operational status, together with temperature values and data logging. All alarms shall be available for review on each School's front end and all temperatures shall be logged and extracted graphically for review. All logging data shall be stored in a SQL database for external use. The electrical meters supplied by the electrical contractor under the LV switchgear shall be connected to the BEMS electrical meter system supplied under the electrical contract and all information shall be integrated within the same software package. The BEMS software shall therefore link into the electrical system on the one screen.

The following information details the requirements for the controls installation works necessary for the completion of this Contract including the school Heating Plantroom and field controls.

The BEMS systems must be able to be integrated and accessed/interrogated by the School's new front end. Upon completion of the works, graphics shall be provided on the school front-end PC's indicating all new plant and to display plant schematic, temperature setpoints, time programmes, temperature readings, meter readings, alarms and energy monitoring.

The Contractor shall take special care when setting the controllers and actuators up to ensure that the actuator responds in a linear fashion to the output.

All BEMS mechanical field equipment including but not limited to control panel, control valves, sensors, meters etc shall be supplied & installed by the mechanical contractor but wired and terminated by the electrical contractor. Final terminations at the MCC Control Panel and field equipment to be carried out by the electrical contractor.

The contractor should note that whilst every effort has been made to pick up all control points required for the installations on the line drawings, these may not be exhaustive. To this end, the specialist contractor must allow for any additional controls required to ensure the controls functionality described within this specification is achievable. The mechanical contractor should ensure that the controls specialist has full information required, that is all parts of the specification and all drawings and is included within the contract team project meetings from an early stage.

The final controls and operation strategy shall be agreed with the Consulting Engineer / School on site but the contractor is to ensure that sufficient costs are included to cover minor alterations to functionality that can be achieved via re-programming.

All time and temperature settings shall be agreed with the Consulting Engineer during commissioning. The specialist sub-contractor shall make allowance for 2no. demonstrations and training the School in the use of the new controls installation. A period of not less than 3 days should be allowed for this purpose.

During demonstration stages at the end of the project the contractor shall be responsible for manually checking the space temperatures in the areas where BEMS temperature stats are installed when operational with separate calibrated hand held monitoring devices to confirm the accuracy of the BEMS sensors and should at this point control sensors be not recording accurate data they shall be replaced at the contractors cost.

The controls specialist shall allow for a full service and checking of the BEMS system at the end of the defects liability period and updating the Energy Monitoring traffic light system based on the schools usage over the first 12 months of usage.

The process for the wiring of control items shall be as follows:

- The mechanical contractor shall issue a list of mechanical plant and it's wiring requirements and power ratings to the controls specialist.
- The mechanical contractor shall, in conjunction with the controls specialist, prepare a list of wiring requirements including power ratings and issue the list to the electrical contractor.
- The electrical contractor shall review and add cable lengths and proposed cable type and cross sectional area and issue this completed list in excel format to the Employer's Representative.
- The Employer's Representative shall confirm the cable sizes required and return the document to the electrical contractor.

- The electrical contractor shall wire all mechanical equipment that requires direct power wiring from local distribution boards and all field wiring between field items such as wiring between window control panels and motors.
- The electrical contractor shall wire devices that are inserted into a supply such as temperature stats.
- The mechanical contractor shall mount wall mounted control devices such as temperature sensors and stats.
- The electrical contractor shall wire controls and power wiring that requires wiring to BMS panels.
- The electrical contractor shall terminate all power wiring for equipment.
- The electrical contractor shall provide a list of all points and confirm that each point has been terminated and inspected.
- The controls specialist shall terminate the controls wiring, test each point and provide a checklist showing each point and confirming that it has been tested for continuity and function.

14.3 BEMS CONTROL PANEL

A new wall-mounted Mechanical Control Panel complete with a BEMS outstation and GSM module shall be provided in the new extension and existing Plantrooms. A network link shall be provided between the new extension central BEMS panel and the new central BEMS panel in the existing Plantroom to allow open communication between the two control panels for sharing of information. A smaller wall-mounted Mechanical Control Panel complete with a BEMS outstation shall be provided in the Staff Office of the existing building. A network link between the control panels shall allow open communication for sharing of information. A new front-end screen and PC in the designated building managers office in tandem with the web-based access on the local FET building network shall also be provided.

Each control panel shall be provided with a touchscreen interface for access to setpoints, sensor readings and alarms. The touchscreen must be installed at 1500mm AFFL and should be supplied for on-site installation to allow for varying panel mounting heights. The touchscreen shall indicate all functionality controlled by the BEMS panel.

The Motor Control Centre (MCC) panels shall be type Form 2b Classification, in accordance with IEC 61439 and IS 10101:2020 and shall be protected by a Miniature Circuit Breaker. Fuses are not acceptable. Panel labels and wording shall be agreed with the Engineer during the Technical Submittal process.

The MCC control panels shall be complete with Hand/Off/Auto selector switching for all items of plant with full functionality and indicator lamps, red for fault, green for healthy.

Each BEMS control system shall relay all information back to the central monitoring system / front end and the electrical metering system.

Each BEMS system shall have the facility to allow the School Principal / Building Manager to remotely access their system for the purpose of controlling and monitoring the system. A fault alert facility shall be provided within each BEMS which allows faults to be reported to designated persons via text message and email.

All alarms shall be available for review on each school front-end and all temperatures shall be logged and extracted graphically for review. All logging data must be stored in a database for external use.

An energy monitoring and targeting system shall be provided for each school. The BEMS systems shall be based on a simple traffic light system. The BEMS system shall provide an overview of the building energy usage for heating fuel, electricity, mains water and make-up water usage. This information shall be available on the BEMS control panel, the Principal's PC on start-up, over the school's ICT network and remotely. Monitoring and alarm via a Global System Mobile Communication system (GSM) alert required personnel of any problem shall also be provided.

Please refer to the ME-5800 Series of drawings for Mechanical Wiring and control points.

The new BEMS panel shall incorporate 30% additional spare capacity on the requirement detailed within this specification to allow for future expansion.

The controls specialist shall allow for the programming of 20no. webpages on each front end to provide the required information for each School's monitoring and control. The BEMS shall be capable of displaying general layouts, Plantroom schematics, temperature setpoints, time programmes, temperature readings, meter readings, alarms and energy monitoring as detailed below.

14.4 CONTROL PANEL COMPONENTS

All control panel MCB's and contactors must be either ABB, Siemens, Sprecher-Schuh or Square D. All other components within the control panel must be manufactured within the EU.

14.5 MECHANICAL WIRING

The electrical contractor shall install all power and controls wiring as indicated on the drawings and shall carry out all final terminations at field devices and at the BEMS panel.

14.6 CONTROLS STRATEGY

14.6.1 Air Source Heat Pump Control

Electric Air Source Heat Pumps (ASHP) shall be the primary form of heating to the existing Plantroom and new extension with gas boiler assistance / backup. The ASHP plant shall be powered via local electrical distribution boards but the BEMS shall control and monitor the Air Source Heat Pump plant and all ancillary pumps and buffer vessels. The ASHP's shall be

setup on a demand-enabled signal from the heating circuit time programmes. The ASHP's system shall have its own immersion sensors in the LPHW heating buffer vessel which shall relay the temperature of the contents in the buffer vessel back to the Heat Pump Controller to maintain a minimum temperature of 55°C(70°C for existing school) flow in the buffer vessels. The ASHP's shall be provided with their own master / slave controller which shall provide the sequencing during heat demand on a duty / assist basis to maintain a primary flow temperature of 55°C(70°C for existing school). The ASHP's shall enable/disable or operate on their integral variable speed drive pumps to maintain the design temperature in the buffer vessel. The BEMS shall also have an immersion temperature sensor in the buffer vessels which shall enable the heating circulation pumps to deliver LPHW flow water throughout the School buildings. The BEMS shall monitor temperature in the flow & return pipework via immersion sensors.

Power for the new ASHP's shall be derived from the local electrical distribution boards. The BEMS shall enable / control and monitor the ASHP on a time clock schedule or as heating / domestic hot water demand dictates.

The ASHP's shall be provided with their own proprietary controller which shall maintain a primary LPHW heating flow temperature of 55°C(70°C for existing school). The BEMS shall monitor temperature in the flow & return pipework via immersion sensors.

If the water temperature in the LPHW buffer vessel is not achieving a design temperature of 55°C(70°C for existing school) during the cooler months, then the BEMS shall enable the natural gas boiler plant and heating circulating pumps to provide assistance in achieving the 55°C(70°C for existing school) flow to the heating header. This will supply LPHW heating water from the boiler circuit to help satisfy the heating demand. When the BEMS sensor sees that the target temperature has been achieved, it shall stop the assistance heating circulating pump.

On ASHP shutdown, the heating circulating pumps shall continue to operate to dissipate heat in the system.

In addition, the Air Source Heat Pumps shall be Modbus compatible with a Modbus cable taken from the BEMS panel to the ASHP's plant with information being capable of being extracted. A minimum of 20no. inputs shall be provided on the Front-End PC.

14.6.2 Boiler Control

Assisting gas boilers c/w internal circulating heating pumps shall be enabled for operation via a demand if the ASHP's plant is not achieving the design LPHW water temperature of 55°C(70°C for existing school) in cooler months. The duty boiler shall be enabled for operation and shall operate together with their own modulating pump on a lead / lag demand basis.

The Boiler Systems operate on a "Lead/ heat demand basis sequence, on successive weeks of a weekly cycle; Automatic advance of this Rotation Cycle will occur each Sunday at midnight, as follows:

For the first week of the cycle, Boiler No.1 will be the “Lead” and remaining Boilers shall operate on temperature heating demands of the heating system for the duration of that week.

After each weekly cycle, each Boiler No.2 will be the “Lead” and remaining Boilers will operate pending heating demands for the duration of that week, and so on.

Once the boilers are enabled for operation they will be controlled by the LPHW flow temperature sensor to maintain a flow temperature of 55°C(70°C for existing school), this will be used to sequence the boilers. A Modulating 0-10v DC signal shall be sent to each boiler to determine the boiler temperature pending outside temperature conditions.

The boiler header flow temperature sensor shall be used to disable the boilers, should the flow temperature rise above 90°C. An alarm will be generated on the BMS front-end.

Each boiler shall be monitored for a lockout alarm signal, and in the event of a boiler lockout alarm shall be activated, a lockout alarm lamp shall be illuminated on the facia of the BEMS panel, an alarm will be generated on the BEMS front-end.

On “Fault” indication from any Boiler System, that Boiler System will be disabled and the next Boiler System in the rotation cycle shall be enabled in its place.

Boiler No.1 shall provide a “Fault” indication if its Boiler reports a “Lockout” fault.

Boiler No.2 shall provide a “Fault” indication if its Boiler reports a “Lockout” fault.

The boiler header flow and return immersion temperature sensors shall have their temperature values logged and will be available for graphical display for review of history readings.

Each boiler flow immersion temperature sensor will have their temperature values logged and will be available for graphical display for review of history readings.

On Boiler shutdown, the heating circulating pumps shall continue to operate to dissipate heat in the system.

14.6.3 LPHW Buffer Vessels

The LPHW Buffer Vessels shall be provided with an Electric Immersion Elements which shall be used to assist with setting up the design water temperatures during commissioning stage.

The buffer shall maintain a mean water temperature of 55°C(70°C for existing school), and shall be provided with a series of probe temperature sensors mounted vertically along the face of the buffer to provide temperature monitoring and demand indication to heat pumps to modulate heating power accordingly.

14.6.4 Frost Protection

Two Stage Frost Protection shall be provided for the heating installation.

First Stage Frost Protection shall enable the LPHW heating circulating pumps when the internal space temperature drops to 5°C. Controls for first stage frost protection shall be hard-wired only – software control is not acceptable.

Second Stage Frost Protection shall enable the heating plant when the temperature of the water in the LPHW return system drops to 2°C. The control valves shall go to the fully open position to allow the circulation of hot water. Controls for second stage frost protection shall be hard-wired only – software control is not acceptable.

The BEMS shall log activation of frost protection to provide information on boiler operation during out of hour periods.

14.6.5 Optimised Start/Stop

The BEMS shall include an optimised self-learning start/stop facility based on internal and external temperatures so that it will automatically start and stop the heating system at optimum times to provide a heated building during occupied periods only. Each zone within the building shall have optimised start stop time schedules, the optimiser shall be set to start with a maximum warm up period of 2 hours and a maximum cool down period of 2 hours.

14.6.6 Heat Dissipation

At the end of each time programme when the heating plant is turned off, all control valves shall be fully opened and circulating pumps shall remain activated for a period of 20 minutes to allow residual heat to be dissipated from heating plant.

14.6.7 Pressurisation Unit

The BEMS panel shall provide a power supply to the pressurisation units and monitor low and high pressure fault signals from the set complete with fault indicators on the face of each BEMS panel. Pressure switches shall be directly hardwired to the control panel and control within the panel shall be hard-wired only – software control is not acceptable. Fault signals shall shut down heating plant and circulating pumps. If any pressurisation unit has been electrically isolated, both fault lamps shall be activated. A panel pressure alarm lamp shall be illuminated on the face of the BEMS panel to indicate a pressure condition alarm.

14.6.8 Heating Circulating Pumps

Pump Operation

Start/stop operation of the LPHW Pump sets shall be determined by the BEMS on the basis of the Time Schedule / Optimisation, DHW requirements or as dictated by the Fabric Protection routine, in conjunction with the Heating Plant.

On shutdown, the BEMS shall run-on the Duty Pump for a minimum of 20 minutes (adjustable), after the Heating Plant has been disabled, to dissipate heat in the system. Then the BMS shall disable the Duty Pump.

When the Duty Pump is enabled, the BEMS shall continuously compare the condition of its Start/Stop Command and Run Status.

The heating flow and return immersion temperature sensors will have their temperature values logged and will be available for graphical display for review of history readings.

Current switches within the BEMS panels shall monitor each circulating pump for run/fault indication. In the event of no flow across the duty pump, an alarm will be generated to indicate Pump flow failure and a red fault lamp shall illuminate on the fascia of the BEMS panel.

14.6.9 Space Heating Control

In general temperature control to controlled environments shall be via local 2-port control valves and electrically powered digital space thermostats with a lockable range of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and shall all be linked on a common bus system to the BEMS.

Valves shall be operated to open when enabled by the zone time programme and then operate open/shut to retain room setpoint temperature.

Room Thermostats shall be as detailed in Part 4: Equipment Schedules. The temperature stats shall provide the following functions:

1. Clearly display the room temperature.
2. Clearly display the room set point temperature
3. Allow the user to easily adjust the set point temperature
4. Operate on a 24V ELV power supply (battery stats are not acceptable)
5. Provide a 24 V power control to a two-port motorized valve

If alternative makes are proposed, they must be as robust as the above. If an alternative is proposed, provide a sample.

Clear Instructions outlining the operation of the local heating controls in teaching spaces should be provided at each controller.

Specification of room temperature stats are outlined in Part 4: Equipment Schedules.

14.6.10 Room Controls

Each room or teaching area shall be provided with 1 no. mains- powered digital thermostat with a lockable range of 20°C +/-2 °C which shall control a number of individual underfloor heating manifold head valves per area as shown on the drawings. Each UFH manifold shall be provided with a two-port motorised zone valve which shall be activated by the zone time programme or run-on timer. Thermostats and manifold specifications shall be as detailed in Part 4: Equipment Schedules.

14.6.11 DHW Control

Each school Plantrooms domestic hot water shall be generated via a DHW Pre-Heat cylinder where the contents shall be raised from 10°C to 50°C on a LPHW heating circuit from the Air Source Heat Pump. The warm water from the pre-heat buffer vessel shall enter the cold side of the gas fired water heater which shall further heat the domestic hot water to 60°C to circulate throughout the school, utilising the high efficiency of the ASHP plant. Immersion temperature sensors shall be positioned strategically on the pipework at the plant to monitor the temperature in the pipework.

The domestic hot water production shall be controlled on a timeclock programme. A hard-wired high-limit thermostat shall shut down the circulating pumps if the set temperature is exceeded which will also raise a common alarm on the BEMS.

14.6.12 DHW Re-circulating Pumps

A DHW secondary return system shall be deployed in each school Plantroom and the DHW return pump shall be enabled on the DHW timeclock programme. At end of occupancy it will run on for 15 minutes to dissipate heat from the hot water plant. The pump shall be provided with it's on board variable speed drive.

If there is a fault with the DHW secondary return pump a RED fault lamp shall illuminate on the facia of the BEMS panel and alarm.

14.6.13 Cold Water Booster Set

Duty / assist cold water booster sets shall be powered, controlled and monitored via the BEMS. The pumps shall normally operate and in the event of a pump failure a RED lamp shall energise on the BEMS panel and alarm.

Float switches shall be provided in each section of the cold water storage tanks and if the stored water levels reach a pre-determined low level set point shall disable the pumps for protection to prevent running on dry.

14.6.14 Water Leak Detection & Alarm System

The BEMS specialist shall provide a water leak detection system at the Cold Water Storage Tank.

A water sensing leak detection cable shall be installed in the drip tray of the water tanks and shall detect water at any point along its length. The sensing cable shall have a smooth design with no place to trap moisture or contaminants and shall not be braided to ensure simple, effective cleaning and instant drying. The sensing cable shall be capable of being cleaned in situ with a damp cloth. The sensing cable and all interconnecting jumper cables shall comply with class 2 plenum rating for LSF (low smoke and fume). Polyethylene cable materials shall be prohibited due to smoke and fumes generated in case of fire. The sensing cable shall be a bright colour and labelled 'leak detection cable' for easy identification and shall be of such construction that no metallic parts are exposed in order to avoid corrosion.

In the event of the cable detecting water it shall instantly close the 2-port solenoid valves on the mains water supplies to the water tanks to prevent further water entering the tanks.

If there is a leak detected within a drip tray a RED fault lamp shall illuminate on the face of the BEMS panel and alarm.

14.6.15 Heat Meters

Heat meters shall be provided on each of the heating circuits, between the flow and return pipework, and shall be wired back to the BEMS panel providing a pulsed output signal indicating energy consumption on the front-end. The meters shall record and display energy usage on the BEMS front end PC. Readings shall be logged on an hourly basis with minimum storage of 1,000 logs and archived monthly to a remote spreadsheet on PC for at least 5 years.

14.6.16 Mechanical Ventilation Controls

In general, local extract ventilation shall be powered from the local electrical sub-distribution boards and enabled via a local PIR Presence Detector in the space. Local extract fans shall not be connected to the BEMS.

14.6.17 Classroom Mechanical Heat Recovery Ventilation (MHRV) Operation

Each teaching space shall be provided with a Mechanical Heat Recovery Ventilator (MHRV) unit to provide fresh air for occupancy. The unit shall provide tempered supply air to the teaching space and remove stale air and exhaust to external.

The MHRV unit shall be powered via local electrical distribution boards but shall be enabled for operation under the dictates of their time schedule via the BEMS. The MHRV units shall also be enabled via a PIR during the time schedule to turn the unit off if the teaching space is un-occupied as an energy saving measure.

Each MHRV unit shall be provided with its own Demand Controller and duct mounted CO₂ sensor and shall be capable of ramping up/down the fans speeds to load match the fresh air requirements to the space.

In the event of a common fail of an MHRV unit, an alarm shall be generated on the BEMS and front end. A RED fault lamp shall illuminate on the facia of the BEMS panel.

If a fire alarm condition shall occur power to the BEMS panel shall be shut down via an I/O interface unit and the control circuit shall be killed and all MHRV units shall be de-energized and shut down.

Each MHRV unit shall be provided with its on dedicated wall controller.

14.6.18 Gas Leak Detection System

Each Plantroom shall be provided with a gas leak detection system with gas detection sensors and suitable for operation on Natural Gas. In the event of a gas leak being detected in the Plantroom by the gas detection system, the control panel instantly slam shut the solenoid control valve, isolating the supply of gas to the building. An alarm shall raise on the gas detection panel and will also send an alarm signal back to the BEMS which will illuminate RED lamp on the facia of the MCC.

The Gas Detection solenoid valve in each Plantroom shall also be interlocked with the building fire alarm system via an I/O interface unit and will slam shut on a signal from the building fire alarm.

The gas solenoid valves will be monitored for its positional status by the BEMS. The Gas leak detection control panels shall not re-start until gas detection alarm has been manually re-set. The gas detection panels shall be provided with volt free contacts for connection to the BEMS.

14.6.19 Run On Timers

In addition to the above the contractor shall provide remote run on timers located in the School office to allow staff to provide heating and domestic hot water out of hours as indicted on the BEMS control points drawings which shall generally provide the following function;

- Space Heating
- Domestic Hot Water

The controllers shall be of a type appropriate for its location in terms of aesthetics and size. Industrial housing shall not be acceptable.

14.6.20 Fire Alarm Interface

In the event of a “Fire Alarm”, HVAC Plant enabled via the BEMS panels shall be shutdown via hardwired interlock. A “Fire Alarm” indicator lamp on the door of each MCC panel shall be illuminated and an alarm shall be sent to the BEMS front-end. When the “Fire Alarm” condition resets, the BEMS shall return the HVAC Plant to normal operation, using the ‘Power Fail Reset’ routine described below. The panel shall be automatically re-set when alarm is de-activated.

14.6.21 Power Fail Restart

When power fails BEMS operated HVAC Plant will be subject to an uncontrolled shutdown. When power resumes, a controlled start-up sequence will take place.

The BMS operated HVAC Plant will be held the off for a period of 60 seconds. The BMS then shall return the HVAC Plant to normal service on a staged basis.

Readings shall be logged on all meters on an hourly basis with minimum storage of 1,000 logs and archived monthly to a remote spreadsheet.

14.6.22 Utility Meters

Please refer to BMS & Mechanical Wiring drawings for details on meters.

Readings shall be logged on an hourly basis with minimum storage of 1,000 logs and archived monthly to a remote spreadsheet on PC for at least 5 years.

The contractor shall provide the following meters which shall be monitored by the BEMS;

- Incoming mains water meters (pulsed)
- Incoming Natural Gas Meters (pulsed)
- Heat Meters
- Electric Switchboard Meters as per LV Schematic

All meters provided by the BEMS specialist shall be mains powered only. Battery meters are strictly not permitted.

Monitoring of the electrical switchboard meters shall be provided via MODBUS protocol or similar to record electrical metering data on the BEMS system. Electrical meters shall be provided by the electrical contractor and the quantity shall be as indicated on the electrical LV switchboard schematic.

All heat meters will be represented on the Front End graphics page for the plantroom. Clicking on the meter location will bring the user to the relevant data logging page. A link from this page will bring the user to the site metering summary page.

The heat meters should record energy in kWh at 15 minute intervals. Readings will be logged every 15 minutes with minimum storage of 5,000 logs and archived monthly to a remote spreadsheet on PC for at least 5 years.

Meters shall be tamper proof or provide indication if a meter has been tampered with.

Readings shall be logged on an hourly basis with minimum storage of 1,000 logs and archived monthly to a remote spreadsheet on PC for at least 5 years. All meters shall relay a pulsed signal of usage to the BEMS.

All meters shall be capable of relaying usage data remotely, with the ability to save historical data for review via internet and be commissioned for same prior to handover.

14.6.23 Remote Panel Boost Operations

The heating zones and water heater shall be boosted from the remote panel. The boost switches shall have a time adjusted setting (1 – 5 hours) for boosting the zone on for a desired time period. A timer indication will display the time setting for boost operations and can be cancelled if required.

14.6.24 Vampire Loads

A vampire load strategy shall be employed to provide a reduction in electrical energy consumption. All electrical loads that are left on standby mode when the school is closed shall be isolated and powered down. Once the school intruder alarm is armed, after 15 minutes the BEMS shall activate the vampire load strategy by sending a signal to all the non-essential LV sub-distribution boards to shut down.

Function shall be available to have the system automatically respond in specific pre-determined time schedules. High quality suitably rated heavy duty contactors shall be installed in order to reduce the risk of failure; all contactors shall be the normally closed type.

Manual bypasses (Hand/Off/Auto) switches on the fascia of the BEMS panel shall be installed in parallel to all dividing contactors in order to provide a manual override function in the event of BEMS, intruder alarm or contactor failure.

The BEMS System shall signal all the contactors, energising them once the building is occupied and the intruder alarm is disarmed, thus allowing conductivity to the non-essential side of all the non-essential sub-distribution boards.

14.6.25 PV Monitoring

A network link from the BEMS to the PV Panels inverter shall be provided where the BEMS shall monitor the electrical energy produced by the PV system and system status. This information shall be available on the BEMS control panel, the building manager's front end PC on start-up, over the buildings ICT network and remotely. Weekly usage figures shall be calculated and displayed.

14.6.26 Energy Monitoring and Targeting

An energy monitoring and targeting facility shall be incorporated within the BEMS. The system shall provide monitoring of the building energy usage for heating fuel, electricity, LPHW, mains water and make-up water usage. This information shall be available on the Boiler Room control panel, the Principal's front end PC on start-up, over the school's ICT network and remotely. Weekly usage figures shall be calculated and displayed. Values shall be compared against target figures provided by the Consulting Engineer and a traffic light system shall be utilised as follows:

- Green: Usage figures fall within set parameters. No usage detected outside of school working hours.
- Amber: Usage figures rise to within 125% of set parameters or short-term usage (no. of hours to be agreed with Consulting Engineer) detected outside of school working hours.
- Red: Usage figures rise above 125% of set parameters or full-time usage detected outside of school hours as indicated by the activation status of the building security alarm.

N.B. The BEMS shall include the facility to calculate 'degree days' in order to assess reasonable gas usage. It will also include a calendar facility to change set parameters according to month. A 'red' activation will trigger instant alerts via a GSM module to a designated mobile phone number.

14.6.27 Energy Targets Review

The commissioning engineers shall return to the school following a full year of operation of the system and in conjunction with the control company and contractor reassess the targets set and confirm that they are correct and match the school's energy usage profile. If they don't remedial action shall be undertaken to ensure proper targets are being met and that the system operates correctly. Where necessary any measurements and remedial adjustments should be applied. This must be completed prior to release of final retention.

14.6.28 Maximum Import Capacity (MIC)

The contractor/controls specialist shall return to the school following a full year of operation and provide the building services engineers with data on the metered electricity consumption to allow the consultant to analysis usage against the design target. They shall advise the school authorities:

- If the target set is reasonable and the applied tariff is correct.
- If there are any benefits to be gained by a lower monthly MIC charge where the MIC is less than the agreed Maximum Demand and where subsequent penalty charges can be avoided.

14.6.29 Summer/Winter Switch

Each BEMS system shall be provided with a summer/winter switch, mounted on the fascia of the control panel. On summer setting, the switch will de-activate the heating circuits time control and retain DHW operation. The frost protection system shall still be active during the summer-selected periods.

14.6.30 Holiday Switch

Each BEMS system shall be provided with Holiday switch, mounted on the fascia of the control panel. The switch shall override the time control and turn off the heating & DHW. The frost protection system shall still be active during the holiday-selected periods.

Holiday switching and overtime switching (up to five hours) shall be provided on the heating centre control panel and the Principal's remote out of hour's switches for occasional out of hours use.

14.6.31 Local User Interface

A touchscreen display panel shall be provided on the fascia of the BMS panels which shall allow full access to setpoints and time schedules and allow the user to graph sensors as required.

Lamps, Hand/Off/Auto switches shall be provided on the fascia of the panel as described herebefore in this specification.

14.6.32 Front End Metering Summary

The Front End metering summary should list all recorded meters by plantroom and then by type, allowing the user to click on each one to access stored data and graphs. The page should include the facility to change metering interval of each meter from 15 mins to hourly, daily, weekly, monthly and annually as required.

A facility to automatically download data to a nominated location at specified intervals shall be provided.

15 (67) FIRE PROTECTION SERVICES

Protection services to enable the building occupants to evacuate safely against the risk of fire shall be provided in the form of hand held type portable fire extinguishers and fire blankets as details on drawings and in Part 4: Equipment Schedules. Exact locations to be agreed on site in conjunction with the Employer's Representative / Fire Engineer.

All fire extinguishers shall conform to BS EN 3-3 1996 'Portable fire extinguishers. Construction, resistance to pressure mechanical tests' and BS EN 3-7 2007 'Portable fire extinguishers. Characteristics, performance requirements and test methods. All usage, siting, inspection and maintenance of portable fire extinguishers shall comply with IS 291: 2015. Allow for supplying the suitable and relevant wall signage inline with IS 291: 2015 for each fire extinguisher which indicates what type of extinguisher it is.

Extinguishers shall be mounted so that the carrying handle of larger heavier extinguishers is about 1 meter from the floor, but smaller extinguishers shall be mounted so that the handle is about 1.5 meters from the floor.

Where automatic extinguishers are suspended in heating center Plantrooms above burners, they shall be fixed to an appropriate rigid frame so that they cannot rotate freely when discharging under pressure.

The Contractor shall also allow for the following:

- Providing wall brackets for all extinguishers and allow for mounting all extinguishers
- Providing and install wall mounted signage above all fire extinguishers identifying fire point and extinguisher type/usage.
- Providing a fire assembly appoint sign and mount externally in the location indicated by the clients representative
- Agreeing exact locations with the Employer's Representative / Fire Engineer prior to mounting extinguishers

16 COMMISSIONING APPENDIX

Commissioning of systems shall be required to the highest standard and shall comply with all relevant documentation. The commissioning works shall be programmed and phased to suit the main contract programme.

The Contractor's appointed commissioning specialist shall undertake, manage and co-ordinate all aspects of the testing and commissioning. Each plant item shall be tested and commissioned by the respective manufacturer.

The Contractor and commissioning specialist shall be in attendance to witness any off-site tests on plant and equipment and the successful commissioning of plant once installed. All associated commissioning reports shall be produced at the end of the Project.

Commissioning shall mean the advancement of all the building services systems from the state of static completion to full working order adjusted in accordance with the design requirements.

Testing and commissioning shall be undertaken within the remit of the integrated building handover procedure.

All systems shall be tested and commissioned in strict accordance with the Master Specification.

Commissioning test sheets shall be provided for each individual test. They shall state the test to be carried out, by whom, method statements, instruments to be used including calibration tests, pass and fail criteria, the results obtained and a statement of whether the test was a pass or fail.

Calibrated instruments must be used for all tests and the associated calibration certificate shall be included with the test sheet.

Demonstration and witnessing of commissioning will be a 3-stage procedure. The contractor shall initially verify to himself that all tests have been successful and forward the associated paper work for review by the Engineer. If the results tabulated are deemed acceptable by the Engineer, the commissioning and proving of the operation of the systems shall be witnessed by the Engineer on site. Only once these results and associated operation of the various systems are proved acceptable by the Engineer and he has signed the associated test sheets shall the systems be demonstrated to the Client and/ or his representative.

The works shall not be deemed Practically Complete and ready for handover until all tests have been successfully demonstrated and the results confirmed as acceptable by both the Engineer and the Client.

Commissioning of Air Distribution Systems:-

The air systems shall be balanced in accordance with the CIBSE Commissioning Code (Series A) "Air Distribution" and BSRIA Application Guide 3/89 "Commissioning of Air Systems in Buildings" June 1989.

Each room shall be fully tested, commissioned, demonstrated and proven in accordance with the following and other specified requirements. A steady state running period shall be provided. Proving periods shall be a minimum of three days. If any areas do not remain within the desired room conditions or any plant has faults or fails the complete 3 day test shall be repeated until such times as the results are proven satisfactory by the Engineer.

Recording equipment shall be installed in each room to prove its acceptable performance. In addition full logging and print outs shall be provided from the BMS for all monitored information.

As a minimum, tests shall include:-

- Supply air volumes and extract air volumes at each diffuser/grille and total at each fan and the associated fan speed and inverter setting.
- Simulated power failure.

On completion of the proving period, all results shall be fully documented and submitted to the Engineer a minimum of two weeks before handover. These results will only be recognised if all results prove satisfactory.

Flushing, Cleaning and Chemical Dosing of Water Systems:-

Water systems shall be flushed, cleaned and chemically dosed in accordance with the BSRIA Application Guide 1/89 "Flushing and Cleaning of Water Systems" and 8/91 "Pre-Commissioning Cleaning of Water Systems".

The Contractor shall monitor the cleaning, flushing and chemical dosing of the various water systems to ensure that the requirements of the BSRIA Applications Guides are complied with prior to commencing the commissioning process.

Cleaning, flushing and chemical dosing shall be carried out by the Contractor, but shall be to the satisfaction of the commissioning specialist.

After water systems have been flushed, and all debris removed, the Contractor shall chemically dose the systems to eliminate corrosion scale formation and micro biological growth.

Commissioning of Water Systems:-

The water systems shall be commissioned in accordance with the CIBSE Commissioning Code (Series W) "Water Distribution Systems" and BSRIA Application Guide 3/89 "Commissioning of Water Systems in Buildings".

The testing and commissioning shall include a 3-day steady state running period.

Commissioning of Automatic Controls:-

The automatic controls shall be commissioned by the controls specialist in accordance with the CIBSE Commissioning Code (Series C) "Automatic Controls".

The Contractor and the controls specialist shall include for demonstrating the operation of the control system at the end of the Project. This, as stated herebefore, shall be a 3-stage process. Demonstration shall only take place when all of the controls are set up and the proven to the contractor that they are functioning correctly. The associated paperwork shall be forwarded to the Engineer for review and only if the results are deemed acceptable shall the system be proven to the Engineer on site. If these tests prove satisfactory the test sheets shall be signed by the Engineer and only at this point shall the systems be demonstrated to the Client and/ or his representative. Should any fault be detected during any of the demonstrations, the controls specialist shall re-demonstrate the operation at a date agreed and at no additional cost to the Contract.

The controls specialist shall provide all necessary attendances as part of the 3 day steady state running period and any heat load tests. This shall include monitoring of all room conditions and faults during the test period. The controls specialist shall set up all systems to operate at the desired room conditions and for all plant to switch on and off as would be normal for that area. All rooms must remain within the specified tolerances during the steady state running period and no faults must be detected on the operation of any plant or the complete 3 day test must be repeated until such time as the results are proven satisfactory.