THE UNIVERSITY of EDINBURGH
Estates Department

Estates Design Guideline No.3

Mechanical Engineering Services

Important Note on Estates Design Guidelines, Assets & Standards

These Design Guidelines, Assets and Standards and the associated suite of documents have been produced in order to furnish external design consultants and contractors with guidance on required University standards for inclusion within their proposed project design.

These guidelines are to be used as supplementary information during project design stage, and as such, detail the minimum standards expected from the University Estates Department.

Please note, these guidelines do not absolve the project design team including, sub-consultants and sub-contractors of their legal and contractual obligations under, design liability, statutory regulations and health and safety legislation.

EDG No. 3 Mechanical Engineering Services – Approval Procedure	
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services Lead: Building Services Engineer (Mechanical)	Name Signed Off Date
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services – Equality Check Lead: Building Services Group Manager	Name Signed Off Date
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services – Check and Approval Lead: Director of Estates Operations	Name Signed Off Date
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services – approval by EMG	Name Signed Off Date
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services – approval by Estates Committee	Name Signed Off Date
Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services – future review Lead: Building Services Engineer (Mechanical)	Name Signed Off Date

Version Control for Estates Design Guidelines (Assets & Standards) No. 3 Mechanical Engineering Services

Version	Date	Nature of Revision	Author	Approved by	Signed
V 1.0	28th February 2019	New Guideline	DT/SK		
V 2.0	February 2020	Revised Guideline	DN		
V 3.0	February 2022	Revised Guideline	SK	SS	
V 4.0	February 2022	Revised Guideline	SK	SS	

Contents

1 Introduction

The UoE Design Guidelines (as a whole), have been developed for employees of the UoE, Design Teams, Architects, Engineers, Project Managers, external consultants and contractors. This documentation has been developed to enable Design Teams and Contractors to have a broad understanding of the principles that the University of Edinburgh will require to be adopted for any future developments.

The guide is primarily designed to be used in conjunction with Royal Institute of British Architects (RIBA) stages. The actual extent and scope of the design guide to be incorporated for any future development will be based upon the specific projects requirements.

The UoE Design Guidelines aim to discuss strategic matters and does not provide an exhaustive treatment of statutory or best practice design and compliance requirements; its primary purpose is to establish a starting point for design briefs, support the consultation process and outline existing assets and standards. It is the responsibility of Design Team readers/duty holders to ensure subsequent designs are complete, compliant and able to meet the final approved brief when measured in use.

1.1 Important Notice – Essential Prior Reading

It is essential for readers of this document to first refer to the Guide Number 1, entitled Estates Design Guidelines (Assets & Standards) Introduction and Application, which serves to provide the Principles and overview with vital information and context that apply to all projects.

1.2 Purpose of the University of Edinburgh Estates Design Guidelines (Assets and Standards)

The purpose of the Estates Guidelines is to act as a briefing document to give designers an overview of the minimum design requirements, constraints and challenges presented by the University of Edinburgh's particular needs. It applies to all new-build, refurbishment, minor works and change of use projects, including property leased by the University, controlling quality in the production of designs, specifications and the subsequent performance of buildings, developed to a consistently high standard and ensuring continuity throughout the University Estate.

The University of Edinburgh encourages innovation; however, all project Design Teams should ensure that their proposed projects have end user considerations and ease of maintenance at its core.

The use of the University of Edinburgh Estates Guidelines, Assets and Standards will not take the place of, or remove, any of the professional responsibility from Design Teams and Contractors to fully comply with the requirements within this document. Given the complex, diverse and growing estate, not all eventualities can be fully defined within this document.

Should any projects deviate from these guidelines, a technical submittal outlining the deviation, reason why and impact to the University maintenance strategy should be prepared and forwarded to the nominated University project representative for liaison with the Building Services Group (BSG).

A review of this deviation shall be carried out by the BSG; a final decision on the deviation shall be communicated to the appropriate design/construction team.

1.3 Interpretation of UoE Estates Design Guidelines, Assets and Standards

The Estates Design Guidelines, Assets and Standards are required to be issued with all project contractual documentation in order to inform project design and construction teams of expected standards to ensure quality continuity across its Estate.

1.4 Glossary of Terms:

1.4.1 Enforced Requirements

The use of the word(s) ‘shall’, ‘are required’, ‘is required’ ‘must’ or ‘will’ denotes a requirement that is non- negotiable and shall be used as the basis for designs, technical submissions and/or activities. If such a statement conflicts with a statutory obligation then a technical submittal shall be issued to the University project representative for liaison with the BSG for their final decision regarding compliance with the documentation.

1.4.2 Requirements Needing Confirmation

The use of the word ‘may’ denotes a negotiable requirement or indication of a solution, where innovation and further calculation, design and discussion may be required to arrive at an optimised solution.

1.4.3 Quality

The Design Guide aims to arrive at the University of Edinburgh’s highest design aspirations and standards. It may be that, at the University of Edinburgh’s sole discretion, solutions are value managed and then value engineered during subsequent design iterations. Design Teams and Contractors are encouraged to consider where value management and subsequent value engineering may result in an improved financial performance should funding constraints occur. All mechanical and electrical value management and value engineering exercises carried out shall be forwarded to the BSG for review.

1.4.4 Assets and standards

The Design Guidelines endeavours to set out Assets and Standards that will maximise the benefits realisation for the UoE to achieve its strategic objectives and maximise value for money. This will involve coordinated and optimised planning in conjunction with

Procurement, robust asset selection with particular reference to existing legacy assets and standards on the University Estate, for reasons of utilisation and continuity of maintenance, replacement of parts, renewal and ultimate disposal

1.4.5 Currency of Third Party Documents

Where superseded standards and regulatory documents are referred to in the text, the reader shall apply current revisions and amendments to their project. Should there be any ambiguity, the BSG should be contacted for clarity.

1.4.6 Proof

Where the word ‘proof’ is used, e.g. ‘proof is required’, a written report or installation certificate must be produced for approval depending on context.

1.5 Review Design Data Process (RDD)

All proposed designs shall be submitted to the Project Manager and respect Estates Teams and Building Services Group for review and comments, the response will be categorised as follows:

A. Design Team to acknowledge comments and continue to develop the design to the next stage.

B. Design Team to acknowledge comments and update the design in accordance with comments and resubmit for consideration before proceeding to the next stage.

C. Design Team to acknowledge comments and completely review and update the design in accordance to the agreed design principles and resubmit for consideration before proceeding to the next stage.

In addition to the above, the UoE may request specific technical submission to support the RDD and may include the request setting out with proof, e.g. calculations, drawings, etc.

The purpose of the RDD is to ensure designs meet the strategic requirements of the UoE and do not compromise the future operations and maintenance provision. The obligations owed by external architects, consultants and contractors to UoE and their liabilities to UoE is not in any way diminished or otherwise reduced by the RDD.

1.6 The Obligations Owed

By external Design Teams, consultants and contractors to University of Edinburgh and their liabilities to University of Edinburgh is not in any way diminished or otherwise reduced by the approval process. University of Edinburgh is not taking over the roles and duties of the external Design Teams, consultants and contractors who will remain legally responsible for the design and/or works carried out by them or on behalf of their staff, agents, sub-consultants and/or sub-contractors.

1.7 Version Control and Updates

The Estates Design Guidelines are to be reviewed and updated by the Mechanical Engineering Services Working Group by the end of January in each calendar year. The version number will, using 2018 as an example, move from 2018 V1.0 at the end of January to 019 V1.0 for the following year.

The UoE Estates respective Project Management (PM) teams will send e-mail notifications to the Directory of current Design Teams and Contractors appointed, following any update or change.

Any updates to the Design Guidelines, which cause significant change to a project design, should be raised and discussed with the respective Project Management Team and application of the Change Control Process will be required.

Any new items or amended content shall be highlighted in yellow to enable identification of changes from previous versions.

1.8 Purpose of UoE Design Guideline Number 3

The purpose of this document is to set out the guidelines and standards that apply to University of Edinburgh (hereby referred to as UoE) Estate and its design requirement for Mechanical Engineering Services as set out by the Building Services Engineer (Mechanical.) This document will apply to newly constructed buildings and existing buildings scheduled to be refurbished. In some cases, this standard exceeds the Building Regulation requirements, as it represents good practice in the Higher Education sector.

The Building (Scotland) Regulations set out to ensure that new buildings and works achieve the objectives of the Building (Scotland) Act 2003 in terms of health, safety, welfare, convenience conservation of fuel, power and sustainable development and the purpose of this guide will be to provide a standard policy specifying the standard that is required by the UoE.

This UoE Design Guideline Number 3 is for designers, engineers, specifiers, installers and commissioning and maintenance engineers of Mechanical Engineering Services for UoE Estates from the Developed Design Stage (RIBA Stage 3) to when the building is in use (RIBA Stage 7):

To align the requirements of the Technical Standards (Scotland) Regulations/Building Regulations and CIBSE guides

To provide an indication of non-prescriptive preferred solutions and appropriate standards. The content is not a statement of requirements or intended to replace existing British or European technical standards or national guidance; reference to these will still be necessary.

If due to the nature of the project, certain aspects of Mechanical Engineering Services are not covered in these guidelines and standards, the relevant codes of practices, British Standards and building regulations are to be applied and followed. For any general and specific queries, advice is to be obtained from the Building Services Engineer (Mechanical.) In the event those documents referred to within this document, which have been superseded, then most recent versions are to be referred to.

Any other doubts, concerns or points of clarification on Mechanical Engineering Services, please contact the Building Services Engineer (Mechanical.)

This document applies to all buildings managed or owned by the UoE. Any tenanted buildings must not have building works, adaptions or change any building or part of a building which will affect the Mechanical Engineering Services or any other building without first receiving permission from Building Services Engineer (Mechanical) and the Landlord of the property or nominated agent and written in the respective lease.

This document indicates the University's generic Mechanical Engineering Services Client requirements. Consultants must also refer to specific project requirements identified by the University's Project Manager and they must fully integrate any new Mechanical Engineering Services with the University's existing legacy systems. Consultants and contractors must obtain approval in writing for any variation from these requirements.

Before incorporating these client requirements in, e.g. tender documentation, etc, please always check with the undersigned that you have current issue of both these client requirements and the field equipment list.

Please always approach the University engineers directly to discuss any point of clarification or possible improvement and to obtain further copies of the client requirements.

Building Services Engineer (Mechanical)
Estates Operations
Estates Department
Edinburgh
EH1 1NP
General enquires: 0131 650 9157

1.9 Legislation and Best Practice Standards for Reference

Any design must, as a matter of statute, be compliant with the Health and Safety at Work Act 1974, any relevant legislation and associated Approved Codes of Practice (ACOP's.)

Examples of secondary legislation include; the Provision and Use of Work Equipment Regulations 1998 (PUWER), the Workplace (Health, Safety and Welfare) Regulations 1992, the Electrical Safety at Work Regulations 1989, the Control of Major Accident Hazards Regulations 1999, the Confined Spaces Regulations 1997 and the Gas Safety (Installation and Use) Regulations 1998.

Your attention is drawn in particular to the legal duties placed on designers by the Construction (Design and Management) Regulations 2015.

Suitable and sufficient safe access for maintenance and repair must always be provided.

The following CIRIA guides should be used to inform your decisions; Construction Work Sector Guidance for Designers (C662), Workplace "In-Use" Guidance for Designers (C663) and Construction Work Sector Guidance for Designers (C662D.)

The University will comply with all relevant legislation and regulations relating to the design and structure of the building. Academic, administrative buildings and all residential property are subject to the requirements of the Technical Standards (Scotland) Regulations/Building Regulations and CIBSE Guides:

- Guide A Environmental Design
- Guide B1 Heating
- Guide B2 Ventilation and ductwork
- Guide B3 Air conditioning and refrigeration
- Guide B4 Noise and vibration control for building services systems
- Guide C Reference Data
- Guide D Transportation systems in buildings
- Guide E Fire Safety engineering
- Guide F Energy Efficiency
- Guide G Public health engineering
- Guide H Building control systems
- Guide K Electricity in Buildings
- Guide M Maintenance Engineering and Management

These standards allow detailed professional knowledge and judgement to be applied in order to develop a final design solution, which will satisfy projects that are more complicated.

The list of legislations, regulations and guides above is not exhaustive. The Design Team shall prepare and submit project related list as part of RIBA Stage 3 design submission.

2 Mechanical Engineering Services Design Criteria

The design criteria outlined in the following sub-sections should be considered the minimum acceptable standards and reference shall made to the UoE Sustainability Guidelines, which may impose more stringent requirements.

2.1 External Conditions

External conditions shall align with CIBSE Guide A – Environmental Design.

Where plant and equipment is required to operate continuously or for the purpose of AHU frost coil sizing or pipework frost protection the design winter temperature should be taken as -10°C.

Where heat rejection plant and equipment is expected to operate continuously serving critical infrastructure or building operation, it should be capable of operating when the external temperature is 32°C and 50% saturated providing full design capacity.

2.2 Internal Comfort Conditions

Internal comfort conditions shall align with CIBSE Guide A – Environmental Design.

The following internal conditions shall be considered for each internal space:

- Fresh air rates
- Air change rate
- Thermal comfort
- Sumer design temperature
- Winter design temperature
- Humidity level
- Filtration
- Internal noise level

For laboratory areas please refer to University of Edinburgh Laboratory Ventilation Policy.

2.3 Thermal Comfort

Thermal comfort is to be assessed for winter and summer based on **CIBSE TM52**: The Limits of Thermal Comfort: Overheating in European Buildings. Unless otherwise agreed, environment types are as follows:

- New building and major refurbishments: **Type II**
- Existing buildings: **Type III**

2.4 Noise Criterion

Several alternative guides to acceptable ambient noise have been published in recent years. These have been referred to in CIBSE Guide A. The designers are encouraged to review these guides as part of the design process:

- BB93 – for teaching environment
- BCO Guide to Specification – for office environment
- DOH Technical Design Manual – for laboratories

Plantrooms shall be designed to meet CIBSE Guide A: Environmental Design – recommended comfort criteria for factories/light work environment.

2.5 Plant and Equipment Performance Criteria

All plant and equipment selections shall comply with the minimum efficiency backstops outlined in the current version of the **Non-domestic Building Services Standards Compliance Guide for Scotland**.

Break-out noise from externally mounted plant or dedicated plant rooms affecting University teaching facilities only and shall **not** exceed a background sound level of 58 dB A, (NR 50) at 3 metres from the plant and equipment or plant room.

Noise generation from building services systems shall not exceed the maximum daytime and night time noise pollution limits required by the Local Authority. Should there be no limits issued by the Local Authority, then designers should align their design to the World Health Organisation document – Guidelines for Community Noise 1999.

Stand-by generators and emergency equipment may be exempt subject to agreement from the Local Authority. All necessary approvals shall be in place prior to installation.

All plant items shall be evaluated to ensure that noise and vibration during operation does not have any adverse impact on the building users or any processes being undertaken within the building.

All mechanical plant shall have minimum of 2 years manufacturer’s warranty, unless specified otherwise within this guide.

Access to all main plantrooms shall be via ASSA ABLOY 1-2 key.

Access to all secondary plant distributed throughout the building and located at low level shall also be protected via 1-2 key or special key agreed with the estates department (i.e.: local risers, plate heat exchangers unit, heat interface units, commissioning valves).

2.6 System Resilience

The design consultants shall provide resilience strategy for the proposed mechanical services in the building. The strategy should be developed during early stage of the design (i.e.: RIBA Stage 2). The following key considerations should be included:

- Facility type (learning and teaching, research, accommodation, data centre);
- Functional requirements;
- Resilience level of site infrastructure;
- Description of proposed HVAC and Plumbing systems;
- Systems and components configuration (N, N+1,2N);

2.7 Building Operating Heating and Cooling Temperatures

A key factor in the drive towards net zero are system operating temperatures. Lower heating and higher cooling operating temperatures facilitate the connection of renewable energy sources such as heat pumps or low temperature district energy systems.

Pumping energy and the capital cost of the system could also be lower if flow rates are reduced by increasing the difference between flow and return temperatures. Lower operating temperatures and lower return temperatures can be achieved through appropriate building services design, i.e. by using larger heat emitters and selecting suitable approaches to controls. This may lead to higher costs for the building services but improves energy efficiency, reduces carbon emissions and the payback period. Therefore, there is a requirement for the Designer to optimise operating temperatures.

The Designer shall undertake an assessment of possible operating temperatures and submit to the UoE Development Engineer for review and comment. The assessment shall consider the operation over the year, not just at times of peak demand, reducing the flow rates at part load using variable volume control principles and limiting bypass flows is important in order to limit pumping energy.

3 Heating and Cooling Generation

3.1 District Heating Systems

The UoE has a number of district heating networks across the estate providing Low Temperature Hot Water (LTHW) for use as heating and for domestic hot water generation.

Buildings that are located in vicinity of any of the University's district heating networks shall be supplied by the district heating network. No local, de-centralised heat generation equipment shall be provided unless specifically agreed with the UoE Development Engineer.

The following areas are served with LTHW from a district heating main:

- Kings Buildings – whole campus
- George Square – area around George Square including Quartermile, Buccleuch Place accommodation, Teviot Row, Potterrow and the Medical Buildings
- Pollock Halls Residences – area served by north boiler house
- Pleasance Energy Centre – includes Holyrood Campus, Pleasance, High School Yards, Old College, 13-15 South College Street, Lister and Infirmary Street
- Easter Bush – Centre Building, Equine, Greenwood and the Roslin Institute Buildings.

The above respective systems are served by central Combined Heat and Power (CHP) plants as well as gas fired boilers.

A network operated by the UoE Building Services Group will provide LTHW to all buildings connected to a district heating system. At design conditions, this network will operate at the following conditions:

- Flow/return temperatures - 75°C flow and 55°C return (leaving the energy centre). This temperature may be reduced at the entry point of the buildings due to distribution losses of the system;
- Maximum operating pressure – all pipework, valves and components shall be capable to withstand PN16 pressure
- For existing buildings with direct connections the pressure differential at the connection point to the DH system – 100kPa
- For new systems which incorporate the Appendix D Heat Station, the pressure differential at the connection point to the DH system –60kPa
- The systems are variable flow and operate continuously throughout the year.

The district heating design and alteration shall comply with industry good practice such as described in CIBSE/ADE Heat Networks Code of Practice in the UK and the Associated Design Guide.

No aluminium materials or components should be used or present within district cooling networks or buildings with a direct connection.

3.2 De-centralised Heat Generation

Only buildings that are not located in vicinity of any of the University's district heating networks shall be provided with their own independent heat generation plant.

The selection of the fuel source(s) shall be evaluated by the designer and options reported to the University UoE Development Engineer. Depending on resilience level required the building may be equipped with dual fuel energy source or temporary boiler connection.

The following are most common types of de-centralised heat generation equipment owned and operated by the University:

- Gas boilers
- Local combined heat and power
- Heat recovery systems.

The designers may wish to consider various alternative solutions such as:

- Air source heat pumps
- Ground source heat pumps
- Sewage heat pumps
- Biomass boilers
- Electric heating
- Any other systems.

3.2.1 Heat Pumps

Heat pump installations shall be designed with adequate provision to maintain suitable heat output in the event of a failure of a single item. This will generally require a minimum of two heat pumps rated at 60% of design load or multiple cascading units (N+1 configuration) unless there is alternative suitable back-up.

In order to minimise starts at low load conditions, the system shall include a thermal store or a buffer vessel.

All heat pumps shall comply with BS EN 14511:2018 Parts 1 to 4: air conditioners, liquid chilling packages, heat pumps for space heating, cooling and process chillers with electrically driven compressors.

Selection of refrigeration systems shall consider the restrictions imposed by the F-Gas Regulations. A low Global Warming Potential is required which no future phase out plan. The selection shall be submitted prior to the end of the design phase for approval by the UoE Development Engineer.

Low noise, energy efficient heat pumps with low vibration levels shall be provided.

Heat pumps shall provide suitable turndown rations in order to maintain system performance at low loads.

Heat recovery is the most energy efficient way of providing heat to buildings, therefore, the use of simultaneous heating and cooling heat pumps should be maximised.

All proposed suppliers of Heat Pump equipment to the University of Edinburgh, must operate on an “open protocol” basis with respect to the provision of spares, parts, software and controls to approved third parties as determined by the University of Edinburgh.

3.2.2 Boiler – Gas

Gas fired boilers installations shall be designed with adequate provision to maintain suitable heat output in the event of a failure of a single item. This will generally require a minimum of two boilers rated at 66% of design load or multiple cascading boilers (N+1 configuration.)

Where gas boilers are supplied in sections, the manufacturer or their approved installer shall assemble them on site complete with a provision of a protective casing and insulating jacket.

Boilers shall be installed on purpose made plinths, stands, plates or prefabricated rig.

Where gas burners are installed, they shall be provided with an acoustic enclosure.

Flue dilution systems are not permitted without prior approval from the UoE Development Engineer.

Application and operation in service:

- Boiler burners shall have fully modulating control
- Link boiler firing to the system shunt pump(s) to allow override operation to dissipate excessive residual heat
- In boilers > 500kW incorporate oxygen trimming controls as part of the combustion control package
- Anti-dry cycling controls shall also be incorporated in boilers > 200kW.
- All non-condensing boilers to be protected by means of back end bypass valves;

Boiler installation should be capable of automatically switching itself on after the event of power disruption.

3.2.3 Local Combined Heat and Power

Application and operation in service:

- CHP sized to accommodate a base load throughout the year with 4500 running hours potential, load assessment will be submitted to BSG manager for review upon request
- Plant and equipment to be selected with low discharge of noise to ambient and attenuators fitted as required to mitigate nuisance
- CHP buffer vessel capacity must be suitable and sufficient to prevent cycling and hunting

- The heating system must design for the CHP to enable it to be taken out of commission for maintenance
- The CHP unit needs to be low NOx, less than 250mg/m3 at 5% O2
- The CHP must be connected to a variable flow system with two port control and low return temperatures
- Flue to comply with Clean Air Act, Local Authority Regulations and the DEFRA Clean Air Strategy 2018
- Modulation control shall be adopted
- Where jacket water coolers/oil/engine exhaust coolers are employed, re-use of the CHP waste heat shall be investigated
- The power supply shall be G59 Embedded Generator Regulations compliant
- Package gas turbine CHP or reciprocating engine within enclosure c/w proprietary controls system
- All flue seals shall be suitable for the maximum flue gas temperature assuming no heat recovery takes place between prime mover and flue outlet.

3.3 District Cooling

Cooling systems are used by the University to provide chilled water for use in conditioning the internal environment and rejecting heat from process water. In addition, the principle of useful heat to be recovered for re-use when economically practical, serves to underpin the University's Sustainability agenda.

A risk assessment is required for animal areas and/or critical operational areas, e.g. main computer server rooms, where the maintenance of specified temperatures is either legislative or operationally required. Such considerations should include 100% independent back up with auto changeover, remote alarm of high temperature and/or plant changeover to a continuously manned monitoring position and UPS/standby electrical generator.

Internal condensing units shall not be accepted unless prior approval from the Building Services Group.

Buildings that are located in vicinity of any of the University's district cooling networks, shall be supplied by the district cooling network. No local, de-centralised cooling generation equipment shall be provided unless specifically agreed with the UoE Development Engineer.

The following areas are served with CHW from district cooling main:

- Central Area around George Square
- Easter Bush.

A network operated by the UoE Building Services Group will provide cooling to all buildings connected to chilled water distribution. At design condition, this network will operate at the following conditions:

- Flow/return temperatures when outside temperature is above 10deg: $6^{o}C$ and $12^{0}C$

- Flow/return temperatures when outside temperature is below 10deg: 14°C and 18°C
- Maximum operating pressure – all pipework, valves and components shall be capable to withstand PN16 pressure
- For existing buildings with direct connections the pressure differential at the connection point to the DH system – 100kPa
- For new systems which incorporate the Appendix D Heat Station, the pressure differential at the connection point to the DH system –60kPa
- The systems are variable flow and operate continuously throughout the year.

The district cooling design and alterations shall comply with industry good practice such as described in CIBSE CP 01 – Code of Practice in the UK.

Any proposed connections to the district cooling system must be raised at an early stage to establish the connection viability with the UoE Development Engineer. The following information shall be provided:

- Assessment of building connected load
- Assessment of peak diversified loads for winter and summer operation
- Heating system schematic for the proposed installation
- All new connections to district cooling shall be through plate heat exchanger arrangement as detailed in Appendix D
- Details of secondary side (building side) temporary chiller connection point and proposed location of the chiller on GA plans
- Details of secondary valve armaments for VT and CT connections in the building.

No aluminium materials or components should be used or present within district cooling networks or buildings with a direct connection.

3.4 De-centralised Cooling Generation

Buildings that are not located in vicinity of any of the University's district cooling networks shall be provided with their own independent cooling generation plant.

The selection of the method of providing cooling shall take account of the total cooling demands, the type of cooling required and the availability of fuel/energy sources.

Preference will normally be for chilled water from a modular unit. Central packaged chillers shall generally utilise multiple screw compressors and designers shall require tenderers to identify the COP at design conditions as part of their tender submission. In order to minimise starts at low load conditions, buffer vessels shall be provided. BEMS control should include operational status, on/off and temperature set point modulation.

Cooling systems shall operate on a variable flow basis employing variable speed pumps and two port control valves. When selecting stand-alone chiller equipment, take account for this method of pumping and the varying of the flow rate through the chiller's evaporator, acknowledging any minimum flow rates which may be required. Where applicable, the

system should be protected with the introduction of glycol to a concentration of 25% of the system volume affording protection to minus 12°C.

The following are the most common types of de-centralised cooling generation equipment owned and operated by the University:

- Air/water cooled chillers
- Dry air coolers
- Direct expansion cooling
- Free cooling

The designers may wish to consider various alternative solutions such as:

- Variable refrigerant flow
- Air/water ground source heat pump
- Adsorption chillers
- Absorption chillers
- Adiabatic heat rejection
- Any other alternative systems

Cooling towers must **not** be used, unless expressly agreed with the UoE Development Engineer.

3.4.1 Air/Water Cooled Chillers

All chillers shall comply with BS EN 14511:2018 Parts 1 to 4: air conditioners, liquid chilling packages, heat pumps for space heating, cooling and process chillers with electrically driven compressors. Selection of refrigeration systems shall consider the restrictions imposed by the F-Gas Regulations 2015.

Low noise, energy efficient compressors with low vibration levels shall be provided. A free cooling cycle shall be incorporated into the controls.

3.4.2 Dry Air Coolers

The preferred method of rejecting heat from cooling systems is by means of dry air coolers. Wetted/Adiabatic Dry Air Coolers may also be considered provided there are appropriate water safety systems provided.

3.4.3 Local DX Cooling

Local DX systems shall provide the ability to communicate room temperature, system enable and fault indication to the University BEMS.

Local DX systems shall be employed in locations where no centralised cooling is being provided. The cooling demand (continuous or intermittent) varies from any centralised facility

resulting in its inefficient operation, or standby, standalone cooling is required. Examples of the potential use of local DX systems include; transformer/switch rooms, communications rooms, meeting/conference rooms, specific laboratories, etc. However, lower energy solutions, such as supply and extract air ventilation with local thermostat, are to be considered on the grounds of future maintenance burden. Selection of refrigeration systems shall consider the restrictions imposed by the F-Gas Regulations 2015. Again, consideration of the consequences of equipment failure is essential.

3.4.4 Free Cooling

Free cooling is the most energy efficient way of providing cooling to the buildings, therefore, the use of free cooling should be maximised. For this reason the following shall be provided:

- Fresh air bypass on plate heat exchangers in air handling units
- Air cooled chillers with integral controls allowing free cooling cycle
- Water cooled chillers with by-pass arrangement allowing direct free cooling by heat rejection plant.

3.4.5 Central VRF Equipment

The use of a centralised VRF system will only be considered and permitted where there is no connection to the University's district heating or cooling networks. Selection of refrigeration systems shall consider the restrictions imposed by the F-Gas Regulations 2015.

VRF systems shall be considered in buildings with multiple spaces, varying heating and cooling demand and the need for good local control such as meeting rooms where some rooms may be unoccupied whilst others have a very high thermal demand. This system application may be suited to retrofitting older buildings due to their limited space requirements (depending on how ventilation is provided) compared to some other systems. The system compressor shall employ inverter drive technology providing efficient operation on partial and full load.

Systems providing simultaneous heating and cooling, heat recovery shall also be provided.

Refrigeration pipework shall be insulated with Nitrile Rubber (class O grade) preformed flexible pipe insulation.

3.5 General

Any proposed connections to the district heating or cooling system must be raised at an early stage to establish the connection viability with the UoE Development Engineer. The following information shall be provided:

- Assessment of building connected load
- Assessment of peak diversified loads for winter and summer operation
- Heating system schematic for the proposed installation

- All new connections to district heating shall be through plate heat exchanger arrangement as detailed in Appendix D
- Details of secondary side (building side) temporary boiler connection point and proposed location of the boiler on GA plans
- Details of secondary valve armaments for VT and CT connections in the building.

If any of the alternative technologies are proposed, the designer shall consult the UoE Development Engineer at the earliest opportunity. Full feasibility study for alternative heat solution shall be provided for information and review during stage 2 of the project.

The study should include, but not be limited to, the following aspects:

- General description of proposed technology
- Load assessment
- Review of site assessment
- Review of applicable legislation
- Description of operation
- Description of proposed controls
- Typical maintenance requirements
- Annual energy savings assessment
- Annual carbon emission assessment
- Simple cost payback analysis for 10 years
- Simple cost payback analysis for building operation 20 - 25 years
- Plantrooms drawings/sketches
- System schematics drawings/sketches.

4 Heating and Cooling Systems

4.1 Heat Station

The Heat Station Detail provided within Appendix D is the preferred method of connecting of to our District Heating and Cooling Systems.

The PHEs Heat exchangers shall be arranged Duty-Assist, each sized to deliver 60% (total in aggregate 120%) of the peak diversified connected load.

Heat stations shall ensure efficient heat transfer under turbulent flow conditions with load turn down to10% of the specified design load or the minimum diversified demand of the connected load, whichever is the lower.

The minimum diversified demand of the connected load shall be determined through an assessment of observed system load or through demand-based calculations.

Heat station components shall be designed for continuous operation at temperatures of; 110°C, or, a minimum of 10% above the maximum working temperatures of the system they are connected, whichever is the greater.

Internal ambient temperature operating range shall be -5 °C to +45 °C.

Heat station design pressure ratings shall be; 16 bar, or, a minimum of 1.5 times the maximum working pressure of the system they are connected to, whichever is the greater.

For applications in unheated environments, where there is a freezing risk a means of mitigating against freezing risk shall be provided. This shall use the available decarbonised heat source wherever possible. Electrical trace heating shall only be permitted by prior agreement with the UoE Development Engineer.

Target pressure drops across primary and secondary sides of PHEs shall be between 25-30 kPa at full load conditions. Where higher pressure drops are proposed for a particular selection, prior agreement shall be obtained from the UoE Development Engineer.

The Appendix D, Heat Station shall be a single or multiple pre-fabricated skids. Where this is not proposed, the Designer/Contractor shall provide justification for the alternative selection to the UoE Development Engineer.

Substation equipment, including ancillaries shall be arranged to ensure they can be safely maintained throughout their life.

Secondary pump sets shall be selected to give sufficient turn down. Where necessary pump sets shall be equipped with automatic bypass arrangements to protect them outside of normal operating envelopes.

Pressure independent control valves shall be matched to heat exchanger capacities at the specified design temperatures.

When considering approach temperatures, the Designer shall ensure that there is sufficient heat transfer at low loads and low flow rates. Target approach temperatures between the primary and secondary at design condition shall be less than 5°C for applications.

4.2 Heat Recovery Systems

Plate heat exchangers are the preferred option for both air and water systems, for reasons of no moving parts and no cross contamination.

Where these plate heat exchangers units are installed in a building with a BEMS, they shall be supplied as a basic unit without a control panel and the plate heat exchanger operation shall be controlled through the BEMS system.

4.2.1 Plate Heat Exchangers

Brazed plate heat exchangers may be employed where:

- The primary heat input is below 250kW, and
- The Primary and Secondary system is in good condition, is relatively new and does not have current or previous issues with corrosion or poor water quality.

Guidance and approval of the UoE Development Engineer should be sought during the design stage.

Where the above does not apply, PHEs shall be gasket type.

Gasket type Plate Heat Exchangers

Gasket PHEs shall be:

- CE certified (PED)97/23/EC.
- WRAS approved as required for the application
- counter current type

Plate material shall be AISI304 or AISI316 stainless steel.

Gasket material shall be EDPM or Nitrile.

Frames shall be sized to accommodate 20% future expansion

Brazed Plate Heat Exchangers

Brazed PHEs shall be:

- CE certified (PED) 97/23/EC.
- WRAS approved as required for the application
- counter current type

Plate material shall be AISI304 or AISI316 stainless steel.

Brazing material shall be copper.

Factory installed ‘Cleaning in Place Valves’ shall be fitted to assist with flushing.

4.3 Thermal Stores

Thermal stores shall be designed to:

- Optimise techno economic and carbon reduction for the project
- Ensure resilience of energy supply

Thermal stores shall be vertical and have a height to diameter ratio of no less than 2:1, ideally 2.5:1.

Where possible a single thermal store shall be used, to minimise capital cost and heat losses. Multiple small stores shall be avoided where possible due to adverse impacts on stratification.

Where multiple stores are required (for example due to space constraints, transport constraints, planning requirements, structural implications, manufacturing/fabrication processes etc), these shall be interconnected to ensure stratification.

Thermal stores shall be designed and manufactured in accordance with the Pressure Equipment Directive PED/97/23/EC

Inspection Manways shall be included. These shall typically be with davit door.

Vessel connections shall be flanged branch for flow and return connections, valves and fittings, BSP for gauges and sensors unless otherwise stated in the Contract Documents. Flanged connections shall be to BS EN 1514-4.

Inlet and outlet connections shall be designed to limit velocities in line with the recommendations of CIBSE CP1 2020.

Thermal stores shall be supplied with multiple sensor pockets. Pockets shall spaced evenly up the useful height of the store.

Pocket and probe depths shall be sufficient to ensure full immersion within the flow.

The thermal store shall be thermally insulated to current BS requirements. This includes the manhole, lifting lugs etc. The insulation for the thermal stores shall consist of 300mm thick, compressed mineral wool or equivalent. Thermal stores shall be clad in a protective Aluzinc or approved equivalent outer coating. Insulation shall be in accordance with BS5422. External surfaces shall be primer painted.

Pressure relief valves shall be installed to protect thermal stores against excessive pressure. Discharge from the valve shall be routed safely to drain at low level. The pressure relief valves shall be positioned such that they are easily and safely accessible for maintenance. There shall be no isolation between the pressure relief valves and the thermal stores.

Automatic air vents and vacuum breakers shall be provided at the top of the thermal stores to allow dissolved air to be expelled and to prevent vacuum conditions within the store. Discharge from the automatic air vent shall be routed safely to the drainage system. There shall be no isolation between the automatic air vents and vacuum breakers and the thermal stores.

Manual isolation valves and a drain cock shall be provided to allow drain down of each thermal store. Drain lines shall be fitted with swan neck connections, routing the valve to an

easily accessible location that avoids the need for the Operator to bend down or climb into the area beneath the vessel.

A bypass line shall be provided for maintenance purposes. Where multiple stores are installed, bypassing of individual stores shall be possible.

A pressure indicator shall be provided in each thermal store line.

For cooling applications, where vessels are located externally and/or where there is a risk of freezing, a means of mitigating against freezing risk in ancillary pipework, fittings and connections shall be implemented.

4.4 Distribution

4.4.1 Heating

Where buildings are connected to a district heating system or are served by decentralised systems, a single constant temperature (CT) circuit shall be provided per building and where required a single variable temperature (VT) circuit shall be provided. Where operational temperatures permit, there may not be a requirement for a VT circuit. A lifecycle assessment shall be provided to the UoE Development Engineer for the approval of the omission of a VT circuit.

4.4.2 Cooling

Where buildings are connected to a district cooling system or are served by decentralised systems, a single constant temperature (CT) circuit shall be provided per building and where required an elevated temperature (ET) circuit shall be provided. Where operational temperatures permit, there may not be a requirement for a CT circuit.

Space cooling shall generally be by the application of chilled beam on a (typically) 14°C flow and 17°C return ET circuit. A single circuit shall be provided per building with two sensor-less VSD pumps and 2-port control valves. Where other forms of cooling are used it is essential that control of water flow be by 2-port control valves. The use of low water temperature systems should be avoided, particularly where operation is required during periods of low external temperature. A lifecycle assessment shall be provided to the UoE Development Engineer for the approval of the omission of a CT circuit.

To prevent conflict between the primary and secondary distribution circuits (adverse mixing affecting flow temperature and flow direction), the circuits shall incorporate the staging of the chillers by flow. In this design approach, the primary flow is always equal to or greater than the secondary flow and carry out pump or chiller staging on the primary side as required to maintain the primary flow greater than the secondary flow.

The provision of cooling to server rooms, IT hubs and freezer equipment rooms, etc, where cooling load would not be proportional to external temperature, design applications should be selected with care. For areas which are operational on a 24/7 basis, the cooling equipment must be selected on the basis of 14°C flow temperatures. Generally, these areas should be provided with air supply to utilise local free cooling.

All design proposals for new and replacement installations must be submitted to the UoE Development Engineer for consideration and approval.

4.4.3 General

Where buildings are connected to a district or are served by decentralised systems, the distribution shall adopt two port valves with variable flow for the control of circuits. A plate heat exchanger shall be interposed between the district and the building energy system.

A two-port system shall be self-balancing and the design should seek to minimise the number of commissioning stations, DRVs and other flow control devices.

All systems shall remain charged with treated water and any drain down time shall be kept to a minimum.

All pump formations shall consist of two single head pumps in a duty/standby auto changeover arrangement. The pumps shall be variable speed drive (VSD) pumps incorporating differential pressure control. Pumps should be selected with a capability of 120% of the design flowrate and pressure.

All main components of the systems shall be equipped with isolation valves. Temperature gauges shall be provided on both sides of heat generating or heat exchanging equipment. Pressure gauges shall be provided on all main system components, i.e. pumps and plate heat exchangers. Test points shall be provided on all terminal devices and terminal units.

Commissioning stations shall be provided on all system branches where the pipework connects to the main riser. Isolation valves shall be provided on all pipework leaving the plantroom as close as possible to the plantroom wall. All pipework shall be routed at least 1m away from electrical distribution zones: switchgear room, electrical risers and DB boards. Where dissimilar metals are used these should be connected via brass connectors or dielectric unions.

Pressure Independent Control Valve (PICV) or Differential pressure control valves (DPCVs) combined with control valves are commonly used on wet systems. The types of valves should allow for the flowrates to be measured and verified on site or additional devices shall be used.

A combined vacuum degasser and pressurisation unit shall be provided. Pressurisation units shall be equipped with N+1 pumps arranged with cascade controls.

A combined dosing pot and side stream filter shall be provided to achieve 5microns c/w DPS across system to alarm BEMS and panel on alarm.

All expansion joins shall be tied.

No aluminium materials or components should be used or present within and heating or cooling system.

Cold water feed to closed loop water systems shall be suitably protected in line with WRAS requirements and metered with BMS connection. Refer to section 8 for further domestic water system requirements.

4.4.4 Pipework and Jointing Systems

A number of pipework and jointing systems may be utilised throughout the estate subject to the building criticality, operational purpose and with approval of the UoE Development Engineer. The system selected shall be capable of delivering the temperature and pressure.

Critical buildings are those which are considered high value from a research, reputational or historical perspective. An example of each are the research facilities at Little France, Main Library in George Square and New College on the Mound.

The following lists to potential materials and technologies applicable to each of the building types. A single material shall be used for each building. Therefore, a heating strategy which is proposed to have a mixture of steel and copper for the heating system will not be accepted. Where working within existing buildings, the existing pipework system and jointing method shall be adopted.

Critical Buildings

Heating pipework within critical buildings shall be medium grade steel (Blue Band), threaded and screwed up to 50mm with flanged connections where the diameter is greater than 50mm. All Pipework within plantrooms shall be welded.

Non-Critical Buildings

Heating pipework within non-critical buildings shall be either:

- Medium grade steel (as above)
- Copper; crimped, compression, flanged, brazed or soldered
- Stainless Steel; crimped, compression or flanged.
- Victaulic grooved couplings and fittings.

Cross-linked polyethylene (PEX) multi-layer barrier pipe with a metallic crimped jointing systems may be considered for small and low value non-critical facilities with the approval of the UoE Development Engineer.

Approval of a system other than Medium Grade Steel can be gained through the submission of a Technical Submission during the design stage. The submission should include the proposed system, manufacturer, installation case studies, technical datasheet and manufacturer's warranty information.

Where extended warranties are available, the preferred system shall be installed by an approved Contractor in order to maximise the warranty of the installation. The Designer shall ensure this is included within the Tender documentation.

General

No joints or fittings are permitted within inaccessible locations.

Where steel pipework is to be run below floors or is generally inaccessible, joints to be welded regardless of pipe size.

Carbon steel press-fit systems are **not permitted** in any proposed pipework installations.

Speed-fit or Push-fit system are **not permitted** in any proposed pipework installations.

4.4.5 Valving and Ancillary Equipment

Safe isolation of any hydronic system is a key CDM and maintenance requirement. On pipework greater than 50mmθ, it is essential the designer shall specifies good quality isolation valves from a reputable manufacturer. Furthermore, Gate Valves shall be provided in strategic locations agreeable with the UoE Development Engineer.

The minimum performance for valving is defined below:

Butterfly Valves

- Robust, ductile iron valve body for long life service
- Valve body fully lugged to fit PN16 flanges
- Temperature range -10°c to 120°c
- Pressure rating: PN16
- Test pressures: Shell: 24 bar seat: 17.6 bar
- Lever operated epoxy coated ductile iron body.
- Ductile Iron body epoxy coated.
- Fully-lugged.
- Stainless steel disc.
- EPDM liner. To suit flange connections BS EN 1092-2 PN16.
- Conforms to BS EN 593

Gate Valves

- Cast iron
- Manufactured in accordance with BS EN 1171: 2002
- Hydrostatically tested to BS EN 12266-1: 2003
- Pressure rating: PN16
- Pressure/temperature operating range: -10 to 120°C at 16 bar, 200°C at 12.8 bar
- UK End Connection: flanged BS EN 1092-2: PN16
- Wedge disc, non-rising stem, inside screw, handwheel operated
- Pressure equipment directive 2014/68/EU.

Rubber Expansion Joints

Rubber Bellows shall incorporate tie rods with inner and outer nuts. Rubber Bellows shall be capable of withstanding the operating and testing, pressure and temperature of the associated system. The minimum performance requirements are as follows:

- Materials: Liner EPDM, hot water resistant, seamless, high abrasion resistance
- Reinforcement: Polymer textile cord, hot water and hydrolysis proof

- Cover: EPDM, ozone proof, heat resistant
- Marking: 2 red bands, ERV DN .., PN .., production date
- Flanges: Swivelling, DIN PN 16, carbon steel, zinc plated
- Operating conditions: Temperature range (depending on medium) -40°C up to +130°C, temporarily up to +150°C. Electrically dissipative.

The handover Asset List shall include a schedule of the Rubber Expansion Joints. Any deviation from these requirements shall be agreed with the UoE Development Engineer.

4.4.6 External Pre-Insulated Buried Pipework

External pipework should comply with CIBSE/ADE Heat Networks Code of Practice, Design Guide and all associated documents.

Heating

The pipework to be a pre-insulated steel carrier pipe compliant with EN253 and associated EN standards and the design shall be developed in accordance with EN13941.

Cooling

All external buried chilled water pipework shall utilise a steel pre-insulated piping system and comply with BS EN 489:2009 district chilled water pipes: pre-insulated bonded pipe systems for directly buried hot water networks.

General

Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene and comply with BS EN 13941:2003: design and installation of pre-insulated bonded pipe systems for district cooling. The joint closure system shall allow for an air test to be carried out to prove that the joint is sealed against ground water ingress.

The installation shall have a minimum service life of 30 years, designed to operate with the minimum of maintenance and minimum of heat losses.

In designing and installing the system, all necessary expansion/contraction devices and anchors are to be provided as part of the installation.

At all entry and exit points from buildings, inspection pits, proprietary valve chambers, etc., the pipelines shall extend into the structure by a minimum of 350mm with the water proof pipe casing extending a minimum of 150mm and be complete with a suitable water barrier fixed into the structure or to any water/damp proof membrane.

All pipework shall be protected by a leak detection system to provide the actual status of the pipework and detect any issues at an early stage, to mitigate any unnecessary damage and disruption to supply. Where a new pipework installation is to be connected to an existing installation, the new leak detection system shall be linked to the existing and the overall monitoring system reconfigured accordingly.

The leak detection surveillance system shall be zoned and capable of detecting a leak to within one metre through interrogation of the associated leak detection panel. Leak detection as-built drawings should provide an accurate zone reference baseline for the location of leak.

Separate monitoring systems shall not be installed. The leak detection system to be connected to the BEMs via consultation with the Controls Systems Team.

All proposed suppliers of leak detection equipment to the University of Edinburgh, must operate on an “open protocol” basis with respect to the provision of spares, parts, software and controls to approved third parties as determined by the University of Edinburgh.

Where extended warranties are available, the preferred system shall be installed by an approved Contractor in order to maximise the warranty of the installation. The Designer shall ensure this is included within the Tender documentation.

4.5 Water Quality

District networks shall be treated with a synergised nitrite based corrosion inhibitor to 500 ppm.

Decentralised systems shall be treated with a synergised nitrite based corrosion inhibitor to 500 ppm where there is no aluminium present.

Where aluminium is present within a heating system, a multi-metal corrosion inhibitor should be used.

Please contact the UoE Development Engineer for further discussion or clarification on water treatment regimes.

5 Heating and Cooling Emitters

The selection of the type(s) of heat emitters to be employed on a project shall reflect the use of the spaces they are to serve and any other HVAC systems which are proposed. The emitters shall be controlled to avoid any conflict in operation, which will result in the use of excessive energy and discomfort to the users. All heat emitters shall have a rated output in accordance with BS EN 442.

All specified emitters shall be capable to withstand operating temperature and pressure of the heating system.

The designers shall propose the system and to allow for proportional balancing of the system. Local isolating valves shall be fitted to allow for individual branch isolation. Each branch shall be fitted with drain cocks. Air admittance valves shall be located at the high and points of the systems.

Access to maintainable parts of the heat emitters, isolation valves, drains, AAVs and other ancillaries shall be considered at early design stage and demonstrated to the University during handover.

All TRV's shall be Danfoss RA2900 range or Herz ref: 7230-06SP2. All TRVs shall be pressure independent.

5.1 Under-floor Heating

The design and deployment of underfloor systems shall only be heating water based and employ a proprietary pump and manifold. Electric underfloor heating systems shall **not** be used.

All underfloor heating systems shall be zoned to suit the use of the space and provided with local temperature control.

The system shall not be installed in an area with intermittent occupation or where there are high ventilation rates, heat losses or floor mounted obstacles.

The location of any underfloor manifold shall be located in a secure cupboard or riser adjacent to the zones services routed from the manifold. All pipelines above the floor shall be insulated.

Provide an overheating mechanical failsafe safety device with set temperature as manufacturer's recommendations and temperature gauges for the under-floor flow and return water.

The Contractor design shall be submitted for review to Designer and UoE UoE Development Engineer.

5.2 Heated Ceiling Panels

Radiant heating panels to be integrated into the ceiling or service raft. The panels shall be suitably insulated on their upside. Flow and return pipework shall be connected to the units by means of flexible, braided stainless steel pipe connectors.

The panels shall be secured to the structural soffit by means of suitable and sufficient suspension system. Suitable access to ancillaries above the ceiling shall be provided.

The whole of the rear of the units are to be covered with minimum of 50mm thick Class “O” foil backed fibreglass insulation.

5.3 Fan Coils

The units shall have tamperproof access panels secured by means of an Allen key.

Integral grilles shall be manufactured from extruded aluminium with an appropriate treated finish.

All fan coil plant items shall be thoroughly evaluated to ensure that noise and vibration during operation does not have any adverse impact on the building users or any processes being undertaken within the building. Where required, adopt acoustic attenuation plenums on the intake and discharge to the unit. Provide a unit or appropriate attenuation to control breakout noise from fan coil casing.

Flexible ductwork connections from the fan coil to grille plenum shall not exceed 1m.

Condensate pumps should be avoided where gravity drainage is possible.

5.4 Radiators

All radiators shall be fitted with a restricted range TRV on the flow and a matching lock-shield on the return. TRVs should have horizontal heads and be fitted at the top connection of the radiator.

Radiators shall be fitted to give a minimum clearance of 40 mm from the wall and 150 mm above FFL. Contracts should allow for removal of radiators to permit wall finishes and decoration.

All radiators shall be supplied with manufacturer’s brackets, self-bleeding air vents, flow regulating lock shield valves and necessary bushes and plugs.

Where radiators are to be fitted in areas of vulnerable occupancy, they shall be of the Low Surface Temperature (LST) type and all pipework serving such radiators below 2000mm above finished floor level shall be protected to avoid contact. LST radiators shall have a surface temperature not exceeding 43°C.

All radiators shall be finished in powder-coated white RAL 9010, gloss 70 unless otherwise specified.

5.5 Trench Heating

Heating elements shall comprise solid drawn copper tubes expanded into close metallic contact with aluminium plate type fins. The tubes shall be brazed into headers having BSPT female connections. The elements shall be fitted with air vents. Front covers shall be easily removed to facilitate element cleaning and access to control and isolation valves.

Control shall be via a TRV on the flow and matching lock-shield valve on the return. Individual control shall be provided to each room or at every three metres of convector.

The natural convective air path shall be kept clear of any obstructions and the clearances of the air inflow and heated air discharge shall be in accordance with the manufacturer's recommendations.

Zonal thermostatic control shall be provided either directly or remotely to suit the application.

Trench heating floor grilles shall be selected to allow pedestrians and any vehicles (e.g. trolleys) to traverse it and with maintenance access to clear debris.

Casing finishes for wall mounted and skirting heating shall be manufactured from 0.7mm zinc coated steel as a minimum.

5.6 Chilled Beams

Chilled beams can be either active or passive and ceiling or surface mounted unit for heating and cooling. Multi-service beams can be employed. All beams shall be co-ordinated with all other services and finishes components. During design process, modelling of airflows from chilled beam units and proposed furniture layouts is to be undertaken to mitigate draughts to occupants.

Flow and return pipework shall be connected to the units by means of flexible, braided stainless steel pipe connectors.

In addition to the housing of services and controls, the beams shall incorporate acoustic absorption and insulation to assist in the control of noise transmission in the spaces they serve.

5.7 Chilled Ceilings

Chilled ceiling shall only be used where there is limited heat gains to be handled. Flat panel radiant panels are preferred to finned coil batteries set behind a perforated panel. Appropriate insulation shall be provided and environmental controls to ensure that no condensation forms on/in the unit.

5.8 Warm Air Curtains

The building entrances must be protected from uncomfortable draughts. Where warm air curtain is proposed, the design should be based on the following:

- The air curtain should be water based with connection to LTHW system;
- The valve should be 2 port valve rather than 3 port valve;
- BMS shall provide enable / fault signal based on time schedule;
- Speed control shall be controlled between low / medium speed based on door contact with run-on timer;
- Temperature control shall be based on thermostat located near reception desk.

6 Ventilation Systems

The University employs ventilation systems for numerous applications, including the introduction and distribution of fresh air and heating, air conditioning, process and fume control and control of odours, etc. The use of mixed mode or full ventilation systems shall be considered to eliminate the need for artificial cooling.

The type of system(s) selected shall reflect all the statutory and environmental requirements.

Where applicable, the Specific Fan Power (SFP) shall be no higher than the standards set out in the current Non-Domestic Building Services Compliance Guide for Scotland.

6.1 Ventilation System Components

6.1.1 Air Handling Units

Air handling unit framework shall be constructed using 50mm penta-box section, manufactured from 18 swg (1.2mm) Z2 hot dip galvanised steel. The framework shall have a natural galvanised finish.

- All air handling units shall have the following:
- All panels shall be located on closed cell neoprene acoustic gaskets about their perimeter
- Where controls are provided with the air handling unit, they shall be enclosed in a cabinet rated at IP65
- All filters shall be fitted with complimentary differential pressure gauges
- Fan motors shall be wired to local isolators complete with auxiliary contacts. Fan assemblies shall be mounted on vibration isolators. Drive guards shall be fitted to all fan assemblies
- Access shall be provided to each section of plant for inspection and maintenance purposes
- Units shall be constructed to eliminate the transmission of mechanical vibration.

In air handling units which have an air flow rate in excess of 1 m^3/sec, all enclosure panels and access doors shall be nominal 45mm deep and double skinned. The outer skin shall be manufactured from 20 swg (0.9mm) B.S.C. colour coat plastisol (plastic coated steel.) The colour selection shall be subject to any planning constraints imposed on the project. The inner panel skin shall be manufactured from 22 swg (0.7mm) Z2 hot dip galvanised steel. The cavity shall be packed with slab rockwool insulation, with a density of 45kg/m^3 (thermal conductivity of 0.035 W/m°C), compressed between the inner and outer skins, to form a panel with excellent thermal and acoustic properties. In addition these units shall have the following:

- Units shall be fitted with inspection portholes and internal lighting (locally switched adjacent to the exterior of the unit with push back timers

- Suitable permanent lifting points shall be incorporated into the unit base frame or framework.

For ease of handling, larger units shall be transported to site in sections for assembly. All jointing gaskets, sealing materials and hardware shall be provided to allow assembly to be completed.

All units shall be complete with fixed identification, airflow and warning labels.

As a minimum, all AHUs shall be constructed to meet the leakage requirements of DW143 class B (BS1886 leakage class L2.)

AHU's shall be mounted within a plant room environment with adequate space for maintenance (external locations only by prior agreement with the UoE Development Engineer.) All control functions shall be undertaken directly by the BEMS – AHU manufacturer controls will not be acceptable. Each section shall be clearly labelled as to function.

Variable Speed Drives (VSD) should be by stand-alone units, connected to BEMS and should be fitted to all motors to permit areas requiring ventilation to varying timescales and conditions from a single unit. Where appropriate, the number of AHU's should be minimised (e.g. combined) to minimise plant complexity and cost.

Motorised dampers shall be provided between ambient conditions, heater/cooler batteries and controlled to "close" when the ventilation is idle.

Where external intake grilles are at high level, provision should be made for access to the insect screen from within the plant-room.

Flushing loops shall be installed at all heater and cooler batteries complete with normally closed isolating valves. Connections to heating and cooling batteries to be rigid rather than via rubber bellows, unless specifically required by the AHU manufacturer.

Air handling units to be equipped with suitable drainage connection. If water traps are used the depth of traps should be confirmed by the manufacturer. Sufficient AHU upstand should be provided to allow for the drainage installation and natural gravity slope towards the nearest floor gully.

6.1.2 Supply/Extract Fans

Supply/extract fans with a duty in excess of 0.5 cubic m/sec shall be type tested to BS EN ISO5801 2017. Generally ventilation fans should be centrifugal, of the backward bladed type with a fan total efficiency of not less than 50%. Belt driven fans are not preferred by the university however where used fans shall be equipped with minimum of two fan belts.

Where appropriate, fans shall be controlled by inverter drives to maximise efficiency and plant life. Supply and installation of the inverter shall be part of the BEMS contract.

On smaller fans and heat recovery units up to circa 3kW EC motors are acceptable.

6.1.3 Filters

Supply air shall be filtered as specified in CIBSE Guide “A” Table 1.1. A set of spare filters shall be provided under the contract and should only be fitted under direction of the UoE Development Engineer.

Panel filters – air velocity at the filter face shall not exceed 1.75 m/sec and manufactured to standard sizes.

Bag filters – air velocity at the filter face shall not exceed 2.5 m/sec and manufactured to standard sizes.

Filter condition indication shall be by magnahelic gauge, no BEMS indication is required.

6.1.4 HEPA Filters

Centralised filter location is preferred to local individual filters.

Filters shall be connected to BMS as well as magnehelic gauges shall be provided.

Filters in the extract ductwork from dusty environment shall be protected by lower grade panel pre-filters.

6.1.5 Humidifiers

Generally humidification shall be provided by employing mains water supplied, resistive humidifiers providing humidity control of ±3%RH. Humidifiers integrated into air conditioning units, close control units, etc, shall be of this type.

Where high capacity humidification is required, an adiabatic evaporative type humidifier, as manufactured by Condair (or an equivalent University approved unit), shall be used. Adiabatic humidifiers shall be supplied complete with filters, pumps, staged control and a purpose-made control panel incorporating UV or chemical sterilisation.

Care shall be exercised to ensure maximum recommended face velocities within the humidifier are not exceeded.

6.1.6 Volume Control Dampers

Shall be constructed with the following characteristics:

- Spindle control, 12 mm square, 100 mm long for use with actuators
- Robust yet lightweight blade and frame construction
- Casing leakage satisfies classes A-D of DW142
- Opposed aerofoil blade operation
- All operating gear shall be fully enclosed and out of ducted airway
- Blade position indicator.

6.1.7 Air Diffusers

Shall incorporate the following components:

- The internal core style shall be selected to ensure that the diffusion of the supply air does not create draughts
- The grille shall be finished in RAL 9010 unless otherwise agreed
- Each grille shall be equipped with an opposed blade damper for air balancing.

6.2 Central Ventilation

All central ventilation systems shall take cognisance of the areas which they serve:

- Use and occupancy of the space;
- Operating times;
- Internal conditions required to be maintained.

In spaces which have similar operating characteristics, consideration shall be given to employing controlled motorised dampers to isolate unused spaces and allow a reduction in the airflow rates through the air handling system.

Variable Air Volume (VAV) is a type of heating, ventilating, and/or air-conditioning (HVAC) system. VAV systems vary the airflow at a constant temperature. The advantages of VAV systems over constant-volume systems include more precise temperature control, reduced compressor wear, lower energy consumption by system fans, less fan noise and additional passive dehumidification.

VAV systems can be particularly energy efficient as they are able to operate the main supply and extract fans at reduced speeds. This can yield significant energy savings from reduced fan power and a reduction in the costs associated with heating and cooling air.

Variable Air Volume (VAV) systems shall be considered where zones with different requirements by varying the quantity of air (and hence the amount of cooling) supplied to each space.

VAV systems can be utilised to control the amount of fresh air being introduced and removed from spaces through the monitoring and control of spatial co2. In larger applications with numerous zones, local motorised damper control (such as TROX or similar) shall be employed with fan pressure controls to reduce/increase airflow rates. This arrangement requires careful testing and commissioning ideally with furniture arrangements in the building space.

For specific guidance on desired HVAC setting in laboratory areas please refer to University of Edinburgh Laboratory Ventilation Policy.

6.3 Dirty Extract Units

The location of all dirty extract systems shall take account of any local openable windows or ventilation air intake to prevent re-entrainment of the exhausting air.

Dirty extract discharges shall be designed to dissipate the exhaust air clear of the building. Roof level discharges are the preferred solution.

6.4 Local and Special Ventilation

The University's activities require varied and extensive application of extract ventilation to provide healthy and safe internal working environments. All system shall comply with the HSE and COSHH standards. The location of all extraction equipment shall ensure that their discharges prevent air re-entrainment into the building or its ventilation systems. The systems shall be designed to provide the required extract performance for the lowest energy consumption.

6.5 Toilet/Bathroom Ventilation Extract Fans

All ducted toilet extract systems shall be served by an extract ventilation system equipped with duty and standby fans complete with automatic changeover in the event of the failure of the duty fan.

The location of all toilet/bathroom extract systems shall take account of any local openable windows or ventilation air intake to prevent re-entrainment of the exhausting air.

All local extract fans shall be controlled by means of PIR linked to integral over-run timers. The PIR can be linked to the lighting personnel detection system as appropriate. Toilets should be maintained under negative pressure.

The ceiling in mechanically ventilated toilets should be fully accessible.

6.6 Kitchen Ventilation

Kitchen ventilation systems shall comply with DW172 – The Specification for Kitchen Ventilation Systems 2018 from BESA.

6.7 Safety Cabinets

When dealing with chemical and biological agents, a formally recorded COSHH assessment must be carried out in conjunction with the University's end users, to determine what level of biocontainment is required, including any LEV (local exhaust ventilation) issues.

- The COSHH assessment (COSHH Regulation 7 which requires that exposure to hazardous substances must be controlled or prevented at all times) must also account for the cleaning/fumigation of safety cabinets as well as everyday use.
- All Microbiological Safety Cabinets (MSC) shall fully comply with BS 5726 Parts 1- 4: 1992
- All projects requiring Cat 2 or Cat 3 containment shall be designed in full compliance with "the management, design and operation of microbiological containment laboratories" – Advisory Committee on Dangerous Pathogens published by HSE

- Designers should consider carefully the intended method of ventilation where MSC's and/or fume cupboards are to be installed. Agreement with the UoE Development Engineer should be obtained before any design work is completed.

To prevent the re-entry of dangerous chemical fumes, exhausts should be sited at least three metres from:

- Windows, doors and other building openings
- Pedestrian walkways
- Nearby buildings
- Nearby flat roofs

6.8 Fume Cupboards Extracts

Please refer to University of Edinburgh Laboratory Ventilation Policy for further details.

All fume cupboard extraction systems shall be installed to run efficiently, safely and with the minimum of noise levels. To achieve these requirements, the extract and ductwork systems shall be designed, installed and commissioned to meet the requirements of H.V.A.C. DW154 (Plastic Ductwork Specification) and B.S.E.N. 14175 (Parts 1 to 7.).

The designers should choose low energy systems over more conventional systems which result in higher energy consumption (i.e: low flow fume cupboards, variable volume fans, lower sash height, wind responsive controls, etc. should be considered and agreed with the end users and UoE Development Engineers during design phase).

The proposal of fume cupboards design shall be submitted for review to UoE Development Engineer.

6.9 Roof-mounted Ventilation Units

The location of the ventilation units shall ensure that safe access for maintenance is provided.

Roof mounted ventilation fans shall be mounted on suitable upstands to prevent rain/snow ingress and provide a kerbing for facilitating the waterproofing of the roof membrane.

Fan selection shall be suitable for mounting on the pitch of the roof.

7 Desired HVAC Installations by Room Function

7.1 Lecture Theatres

Heating and ventilation designs for Lecture Theatres shall comply with the following parameters:

- Heating/ventilation system shall be designed to achieve an occupancy temperature of 21°C in the heating season and 24°C during all other times
- 'Cooling' will normally be achieved by mechanical ventilation unless there are very high internal and solar heat gains
- Displacement ventilation system shall be the system of choice in lecture theatres. Each theatre shall have its individual system
- Fresh air supply rates shall be based on CIBSE recommendations. If a displacement system is used then the rate may be higher
- Air handling unit equipment supplying/extracting air from lecture theatres shall incorporate some method of heat recovery. The preferred system of heat recovery is by the use of a plate recuperator c/w face and bypass section or, if suitable, recirculation. Other methods, such as a heat pipe, may also be considered but run around coils should only be used as a last option
- Ventilation plant serving lecture theatres shall be designed to achieve noise rating no higher than NR30
- Occupancy sensors (microwave type) shall be installed within lecture theatres to enable the controls system to 'set-back' to a lower temperature set-point of 16°C when no movement is detected (see Controls Section)
- Consideration should be given to the control of supply/extract fans either by the use of inverter or two speed controls. CO_2 sensors normally fitted within the extract ductwork would dictate the fan speed. The system should maintain CO_2 levels below 0.08% (800 ppm)

7.2 IT Communications Rooms

Dedicated DX split air conditioning units complete with temperature monitoring/control and alarm linked to the University's BEMS. If adjacent to an external wall, simple supply and extract controlled by a room or equipment thermostat. Design application to be subject to a resilience risk assessment, in the event of a failure and impact on the business.

7.3 Refrigerator/Deep Freeze Rooms

Packaged refrigeration system integrated with the refrigerated store/room complete with temperature monitoring/control and alarm linked to the University's BEMS. Please also refer to the UoE Cold Storage Facility Policy for further details.

8 Domestic Water Systems

All domestic water services shall be designed and installed accordance with:

- The Water Supply (Water Fittings) Regulations and the WRAS (Water Regulations Advisory Scheme) regulations guide
- HSE Approved Code of Practice and Guidance (L8): Legionnaires' Disease 2013. The control of legionella bacteria in water systems.
- BS EN 806-5:2012 (Parts 1-5)
- BS 8558:2015
- CIBSE Guide G
- CIBSE TM13
- Local Water Authority Byelaws

On completion of installation and prior to use domestic systems shall be thoroughly disinfected and on completion of flushing all strainers shall be cleaned and cleared of debris. Designers and Contractors should comply with: PD 855468:2015 Guide to the flushing and disinfection of services supplying water for domestic use within buildings and their curtilages.

Where systems are taken into use during construction the contractor shall be responsible for maintaining water quality on site and ensure full compliance with Table 2.1 of HSG 274 Part 2 with contemporary records provided as part of the O&M manual and continue their duties under HSG 274 Part 2.

8.1 Cold Water Systems

8.1.1 Mains Water Supply and Distribution

Any external mains water distribution shall be run underground in MDPE pipework (or as required to address ground contamination issues.) The MDPE pipework will convert to copper mains water pipework at each of the building entry points.

Site mains water supply meters shall be provided in accordance to No. 5 Metering Design Guidelines and connected via the BEMS system.

All cold water service systems shall comply with the requirements of the HSE Approved Code of Practice and Guidance (L8): Legionnaires' Disease 2013. The control of legionella bacteria in water systems.

Any cold water pipework system in the building dedicated to lab system or any process system shall be labelled in such manner that it is recognisable and readily distinguishable from wholesome water system in the building.

Where pipework branches to serve non-potable water supply (i.e.: heating and cooling system pressurisation unit) the branch should be fitted with in-line spring loaded single check valve installed as close as possible to the source.

Thermal gain into cold water pipework is mitigated by providing suitable insulation and adequate separation from sources of heat such as heating or hot water pipework.

8.1.2 Cold Water Storage

If water storage is required in the building the cold water shall be stored in potable quality storage tanks located internally in tank room or plantroom shared with no heat generating equipment.

Water storage should be minimised wherever possible, it should hold no more than one normal day's water supply. The stored water calculations should be provided to the UoE Development Engineer for review and comment.

The tanks shall be dual compartment with lockable covers, screened vents and overflows, etc., as required by the WRAS Water Byelaws for portable water storage. The construction of the tanks shall be GRP sections with flange bracing and be fully insulated. Further, tanks shall provide the following:

- Overflow and warning pipes shall be installed to discharge externally, i.e. nuisance pipes such that the overflow will be noticed;
- Storage tanks shall have self-draining profiles;
- Storage tanks plantrooms shall allow for sufficient maintenance around the tanks. Typically 1m around the tank;
- Sufficient space above the tank shall be allowed, typically 0.75m;
- Stainless steel fixings shall be utilised for all cold water storage tank installations
- Storage tanks shall have inlets and outlets on opposing sides
- If tanks maintenance requires work at height the safe access and working environment should be provided; Fixed, hooped access ladders shall be provided for all cold water storage tanks to facilitate maintenance. Guarding railing may also be required;
- Water storage tanks shall be fitted with a side access panel to facilitate egress in the case of an emergency;
- Float valve shall be adjustable;
- Mains water pipework connection shall be equal length / pressure to each section;
- The tanks shall be installed on upstand walls or steel beams sections allowing for inspection below the tank level and sufficient space for maintenance (typically 0.45m).
- The tanks should be dedicated for the purpose of cold water storage only. Combined water storage and sprinkler tanks are not acceptable.

8.1.3 Pressure Booster Sets

All units employed on potable water shall be WRAS approved.

Units shall incorporate integrated pressure transmitters, control panel and a variable frequency drive controller. One pump shall be speed controlled and the remainder shall operate at full speed all mounted on a frame for easy installation.

Units shall be equipped with N+1 pumps arranged with cascade controls.

Units shall also be provided with N+1 hydraulic accumulator vessels, individually isolatable with lockable isolating valves.

8.1.4 Rainwater/Greywater Harvesting Tank

The systems are generally not required on new University buildings.

8.1.5 Drinking Fountains

The University of Edinburgh has Drinking Water Policy. All new and refurbished facilities shall comply with the policy, in particular with the provision of water drinking fountains as detail below:

The provision of 1 no drinking water fountain per 1000 m2 for all buildings over 1000 m2, excluding some buildings with extensive research and laboratories and biological research facilities. The drinking fountains are to be strategically located, directly connected to mains cold water supply and installed according to the manufacturer's instructions. Dedicated trapped drainage connection shall be provided. Pumped drainage is not allowed.

The typical water fountain shall be stainless steel, unchilled (i.e.: Franke stainless steel unchilled pedestal unit or equal).

8.2 Hot Water Systems

All hot water service systems shall comply with the requirements of the HSE Approved Code of Practice and Guidance (L8): Legionnaires' Disease 2013. The control of Legionella bacteria in water systems.

8.2.1 Hot Water Storage

Hot water storage shall be provided by 2no. copper HWS unvented storage vessels with plate heat exchangers located in the plant rooms, each capable of providing 66% of the demand. Any commercial kitchen and laundry shall be provided with separate dual storage buffer vessels for their dedicated hot water services.

The HWS buffer vessels shall generally be heated by LTHW heating via plate heat exchangers. The buffer vessels should also be equipped with stand by electric immersion heaters. Electric immersion heater facility shall come complete with a suitably rated simple time clock or run back timer, sufficient to provide recovery period of 4 hours. Refer to Appendix E for the hot water system arrangement.

Storage vessels shall be equipped with the following:

- Suitable inspection hatch (access manhole typical size 600diameter).

- Pressure Temperature Relief Valve
- Anti-Vacuum Valve
- Temperature Sensor 1/3rd from the top of the cylinder
- Drain cock at low level
- Pressure gauge
- Temperature gauge

8.2.2 Distribution

All hot water circuits shall have the following characteristics:

- Monobloc single lever taps are the preferred solution for the UoE on the grounds of future maintenance and cost
- Circuits shall be fitted with a secondary return
- Secondary returns shall be connected within 1m of each final outlet or 500 mm of any thermostatic mixing valve (TMV.) This may be restrictive for back-to-back installations, however, it is best practice is to have return within 1m from outlet, TMV installed at 500mm and return within 500mm of the mixer provides this
- Where TMV's are used, these shall generally be installed within 500mm of each final outlet
- A standby dry secondary return pump shall be provided and wall mounted with capped ends for all installations
- Domestic hot water storage temperature shall be 60°C
- Domestic hot water return temperature shall be 50°C, prior to the connection to the hot water generation.
- Flexible hoses should be avoided except when they are required for vibration or movement.
- Heat loss from hot water pipework should be mitigated by providing suitable insulation and adequate separation from sources of cooling such as chilled water or cold water pipework.
- TMVs, scalding protection and user groups, temperature set to 41°C – 43°C.

The UoE has undertaken the following scalding risk assessment and determined where the type of TMV should be present:

- Every shower shall be fitted with a TMV2
- Every bath shall be fitted with a TMV2
- Every wash hand basin within an accessible toilet shall be fitted with TMV2
- Every wash hand basin which is within accessible accommodation rooms, including summer let accommodation rooms, shall be fitted with a TMV2

- Every wash hand basin within a nursery should have a TMV2
- Every wash hand basin within healthcare premises and is publically accessible, should have a TMV3
- Staff rooms, etc, would not require a TMV.

8.2.3 Heat Interface Units

Localised instantaneous HIU's will be considered when it is more economical to install than a centralised system. However the below parameters MUST be met.

- Mains fed cold water systems only. (No stored Water tanks)
- Applicable to outlets with high usage
- DHW Recirculation not to be used
- Pipe work to be sized so as all DHW Outlets are supplied at 50°C within 45 seconds
- Use would be limited to core spaces of buildings which have a low number hot water outlets such as Individual flats, office buildings and general teaching spaces serving i.e kitchens, tea points and WCs.

8.2.4 Local Hot Water Heaters

Local hot water heaters (single or multi-point outlets) shall be employed where it is not economic to install a centralised storage or non-storage system. For low usage applications, instantaneous units can be used to eliminate the need for storage and save energy. This may apply to small installations such as some University accommodation or remote service points in any building type.

8.2.5 Taps

Single lever mono bloc mixer taps, complete with a 10 year warranty and guarantee period, shall be utilised. Please note for reasons of ongoing maintenance and cost, automatic sensor taps are not a preferred solution, however, it is acknowledged that they do have applications within inclusive design.

8.3 Water Hygiene

Prior to taking into use, the water system in the building shall be pressure tested, flushed and disinfected by water specialist. These activities shall be undertaken in line with PD 855468, British Standards and BSRIA standards. Record of these activities should be provided to the client.

The disinfection procedures presented for cold water storage tanks, domestic hot water vessels and water systems are designed to minimise the risk to staff and others that may come into contact with water which may have been contaminated with Legionella Species pluralis (spp.)

In all instances of draining, water should be drained in such a way as to avoid the creation of an aerosol. This also applies for the safe purging of stagnant water, e.g. from unused outlets.

Temperature sensors for L8 monitoring should be provided in the following locations:

- Hot Water Cylinders (2/3 of the way up);
- DHW Flow;
- DHW return;
- Mains incoming
- Cold Water Storage Tank each section
- Cold Water Storage – Flow

8.4 Backflow and Back Siphonage Prevention

Early engagement between the Designer, Client's Representative and the Estates Department is required to understand the anticipated building/system operation. This will allow the Designer to determine the Fluid Category of each water system and make suitable allowance for the prevention of Backflow and Back Siphonage.

Where possible, Reduced Pressure Zone (RPZ) valves shall be designed out but mean of connecting to a Fluid Category 4 and above system.

The air gap associated with a laboratory sink is often compromised by hose connections installed by the users, in this case it is likely a separate Fluid Category 5 water system would be required. This should be resolved as early as possible in the project.

9 Drainage Systems

9.1.1 Above Ground Foul Drainage

Above ground foul drainage shall be run from stub-stack pop-ups at ground floor slab level to all waste connections. Drainage pipework shall be a modified one-pipe system. Primary vents shall terminate externally at high level through walls, or if unavoidable, at roof level complete with suitable guard/cowl and flashing.

All external, buried and below slab, the main contractor shall install drainage. Floor gullies shall be provided in plant rooms where wet services are installed.

9.1.2 System Standards

The above ground surface water, soil, waste and vent systems installation shall fully comply with the following:

- BS EN 12056: Part 2 and Part 3
- Current Scottish Technical Building Standards
- CIBSE Guide and CIPHE Design Guide

Fire collars shall be fitted to all pipework penetrating floors and walls designated as fire barriers to maintain the integrity of the barrier.

The Local Authority Building Inspector shall inspect the entire above ground drainage system prior to handover.

9.1.3 Plant Room Drainage

Plant rooms shall be provided with adequate drainage provision to service the following:

- Condensate drains
- Tanks and system overflows and safety valve discharges
- General system drain down
- Plant room cleaning

Separate drain points shall be provided to service individual or collective overflows and safety valve discharges complete with suitably sized tundish/trough to control spillages.

All plant room areas which contain cold water storage tanks, hot water calorifiers or buffer vessels/thermal energy, stores shall have such equipment located within a water sealed bund complete with dedicated floor gully/channel.

All condensate drains shall be piped to discharge directly into a floor gully/channel and be so arranged as not to impede the flow of any discharge.

Each plant room containing water based services shall be provided with a hose, 30m minimum length, looped onto a storage spoil to allow controlled drain down of each service.

9.1.4 Plant Area Flood Protection

A flood risk assessment, complete with control measures, shall be undertaken at the design stage to review the risk of flooding of important areas and services of the building, from sources such as water tanks, cylinders, pipework, drainage or external rainwater ingress (list is not exhaustive.)

To control the spread of water following any seepage, discharge, leak or similar incident, the following prevention measures shall be implemented:

- All items of plant, including electrical panels, shall be located on a plinth (typically 150mm high)
- All risers shall be equipped with a water resisting upside bunding kerb (typically 100mm high)
- Plant rooms contained water shall be provided with a bunding kerbs set to allow a full sweep of the access doors (typically 100mm high)
- All cold water storage, hot water calorifiers and heating and cooling plate heat exchangers shall be located in bunded areas, be provided with leak detection tape covering any potential discharge within the bund and have both a local audio/visual alarm and a link to signal an alarm condition through the BEMS
- No water services or drainage shall be installed in electrical sub-stations, switch rooms or data centres.

Please see No. 10 – Building Fabric Guidelines.

9.1.5 Sump Pumps

In all applications, arrangements shall be made to lift and lower the pump(s) without requiring to descend into the sump pit.

All sump pump motors shall have IP 68 protection with Class F insulation and be rated for continuous operation.

Sump pumps shall incorporate automatic float switches to initiate and stop operation. The sump pump installation shall be connected to BMS and security systems providing both high level alarm and plant fault alarm.

9.1.6 Effluent Storage Tanks

Effluent tanks shall be designed and manufactured in accordance with BS 4994/BS EN976.

9.1.7 Chemical, Toxic and Industrial Liquid Waste Drainage

Obtain from the end users, the nature and classification and associated hazards of all liquid waste expected to be used within the facility. No hazardous chemical, toxic or industrial waste shall be disposed of through a building's drainage system.

Note that wastes are classified as 'hazardous' in accordance with:

- The Hazardous Waste Regulations 2005 amended 2016 (Schedules 1 and 2)
- The European Waste Catalogue (EWC) 'List of Wastes' and includes other wastes which display one or more of the hazardous properties (HP1 to HP15) listed in the Regulations (see the Environment Agency Guidance – WM3 – Guidance on the classification and assessment of waste [1st Edition v1.1])

10 Steam and Condensate Systems

The University uses steam for various processes including autoclaves and for cleaning.

Where applicable steam generators must comply with the Guidance on the Safe Operation of Boilers (BG01) compiled by the Combustion Engineering Association (CEA), the Safety Assessment Federation (SAFed) and the Health and Safety Executive (HSE.). In order to ensure the energy efficient use of steam, the provision of a complimentary condensate recovery system shall be made.

The Designer shall investigate the opportunity for local direct electric steam generation and submit a document assessing the benefits and risks to the UoE Development Engineer for consideration.

10.1 Steam Generators

Steam generation plant shall be arranged to provide N+1 generator resilience.

Each generator shall have a minimum thermal efficiency of 93% and where practical, the generator shall be part of a pack unit.

The package equipment shall incorporate complimentary ancillary equipment including:

- Water softener
- Dosing equipment
- Stainless steel insulated feed water tank
- Feed water tank steam injection heating system
- Water monitor facility
- Blow-down vessel, with cooling water facility
- Steam separator and trap set
- Pre-pressure pump system
- Integrated control panel unit
- Remote emergency stopping at points of egress and, where applicable, linked to the fire alarm system.

All proposed suppliers of steam generation equipment to the University of Edinburgh, must operate on an “open protocol” basis with respect to the provision of spares, parts, software and controls to approved third parties as determined by the University of Edinburgh.

10.2 Distribution

Steam distribution pipework shall take the shortest route to the service points. The pipelines shall incorporate strategically located pockets/condensate collection points. The pocket shall

be fitted with a trap to discharge the condensate, to minimise the build-up of condensate within the steam pipework.

- All steam traps shall be accessible for inspection and cleaning
- Automatic air vents for steam systems shall be fitted above the condensate level so that only air or steam/air mixtures can reach them. The best location for them is at the end of the steam mains
- The discharge from an air vent must be piped to a safe place.

10.3 Outlets

All outlets shall be taken from the top of the distribution pipework. All outlet branches shall be provided with isolation valves, strainer, sight glass and thermostatic steam trap.

Outlets shall be fitted with control/regulating valves with low noise and anti-cavitation characteristics.

11 Gaseous Systems

The University employs various gaseous systems as noted below.

11.1 Natural Gas

All gas installations must be installed to comply with the current Gas Safety Regulations and IGEM guides.

These two guides should be adhered to:

- IGEM/ UP/2 Latest Edition – Installation of pipework in industrial and commercial premises;
- IGEM/UP/11 Latest Edition – Educational establishments;

System schematics and all required labelling must be provided in a permanent and durable format in visible location in the plantroom.

In addition to the Emergency Control Valve (ECV), a solenoid operated shut-off valve shall be installed on the gas main pipework as it enters each plant-room or kitchen. These valves shall have provision for manual opening or be fitted with a locked bypass valve. Solenoid operated gas valves shall be tripped by local, emergency push buttons, ventilation interlock systems in the case of kitchen ventilation or by local fire detection on a “two knock” arrangement. General fire alarm activation should not close gas valves.

Gas supplies to all laboratories, commercial size kitchens and teaching areas shall be provided with a gas soundness-proving unit and a means of manual isolation in a prominent accessible position within each laboratory or kitchen, etc.

All proposed underground gas supplies shall be installed in Medium Density Polyethylene (MDPE) pipe to each new building. Pipework will comply with BS 7291 and polyethylene fusion fittings to BS EN 1555. The proposed new gas supply pipework will convert to mild steel pipework at each building entry location.

Pipework up to, and including, 150mm nominal bore will be carried out in black mild steel (medium grade – Blue Band) to BS EN 10255:2004: non-alloy steel tubes suitable for welding and threading

Pipework above this size of carbon steel pipes shall comply with BS EN 10216-1:2013 seamless steel tubes for pressure purposes

Screwed fittings on steel piping shall be best quality malleable cast iron branded or beaded pattern to BS 143 and 1256:2000

Threaded pipefittings in malleable cast iron and cast copper alloy and external screwed tapered thread to BS EN 10226-3:2005

Pipework with a nominal bore of 65mm and above will employ flanges for jointing at periodic distances. Where flanges are used, they will comply with BS: 4504 and to the table suitable for the working pressure of the system.

The new gas supply pipework entering each new building will be fitted with a main gas isolating valve and a gas solenoid control valve, interlinked with the fire alarm system. Main isolating valve must be located in a secure area.

All gas service installations shall comply with the HSE safety in the installation and use of gas systems and appliances ‘Gas Safety (Installation and Use) Regulations 1998 Approved Code of Practice and Guidance’ including all subsequent amendments and also BS EN 1775: 2007 gas supply. Gas pipework for buildings. Maximum operating pressure less than or equal to 5 bar.

11.2 Medical Gas

There are several aspects of gas flow to consider when designing the pipeline distribution system:

- The test flow that is required at each terminal unit for test purposes (this flow is essentially to establish that the terminal unit functions correctly and that there are no obstructions)
- The typical flow required at each terminal (this is the maximum flow likely to be required at any time in clinical use)
- The likely numbers of terminal units in use at any time
- The flow required in each sub-branch of the distribution
- The total flow to the lab/department
- The flow in the main branches/risers, that is, the summation of all diversified flows
- The flow required at the plant, that is, the sum of all diversified flows to all like departments and labs, plus individual or dissimilar departments.

11.3 Liquid Nitrogen Installations

11.3.1 Introduction

The use of liquid nitrogen (LN2) occurs in research activity throughout the University. The number of bulk storage installations should be kept to a minimum and should be installed and maintained to a consistent standard following the guidance below.

Generally, University LN2 installations should comply with the latest issue of BCGA Code of Practice CP 21 (British Compressed Gases Association.)

A liquid nitrogen system shall be designed by a suitably experienced and qualified engineer, the design must include a risk assessment as required by both the Management of Health and Safety at Work Regulations 1999 and the Control of Substances Hazardous to Health Regulations 2002 (COSHH.)

11.3.2 Location

The internal part of the LN2 installation (the LN2 Room) comprises the delivery pipe and valves, cryogenic storage and flask filling facility. An external wall is generally required to permit the high ventilation rates and basements should be avoided. Access must be restricted to authorised personnel only.

The length of the delivery pipe is critical. The location of the internal facility and the bulk storage should be such as to minimise the total length of the delivery pipe. This should be kept below 15m or LN2 waste will be excessive.

11.3.3 Bulk Storage

Location should comply with CP 21 Appendix 2. A vacuum insulated bulk storage tank should be installed within a purpose built compound; this part of the installation is generally leased from the cryogenic gases supplier who will take responsibility for the design, supply and maintenance.

11.3.4 Delivery Pipe

The delivery pipe shall be manufactured from high grade stainless steel and be of the super insulated vacuum line type. All isolation and point of LN2 supply valves shall be suitable for cryogenic service. Supply and installation shall be by specialist contractor.

The delivery pipe shall incorporate an electro-pneumatically operated emergency shut off valve adjacent to the bulk storage tank.

11.3.5 Room Layout

An oxygen depletion monitor shall be provided with sensors mounted 1200 mm above finished floor level. The control unit should incorporate an oxygen % display and be located outside the LN2 Room.

All electrical circuits should be within galvanised conduit. Socket outlets shall be IP65 and 1200 above finished floor level.

A PIR presence detector, emergency “panic” buttons and audio/visual alarm shall be installed.

- Liquid nitrogen shall only be stored in secure plant areas/cages
- All liquid nitrogen storage vessels shall be insulated, vacuum-jacketed pressure vessels, be complete with safety relief valves and rupture discs to protect the cylinders from pressure build-up
- All pipework, vessels, equipment and ancillaries shall be insulated
- Due to the large expansion ratio of liquid to gas, adequate ventilation shall be provided in areas using liquid nitrogen. A minimum of six air changes per hour is to be considered in these areas

- The provision of an oxygen depletion/displacement system is to be made on areas such as laboratories, use multiple inert gases such as argon, nitrogen and helium as carrier gases and also in cryogenics
- Inert gases such as argon and helium, as well as nitrogen, are not toxic but they do not support human breathing and reduce levels of oxygen in the air. They are odourless, colourless and tasteless making them undetectable
- An increase in the concentration of any other gases that are not oxygen, can lead to a situation where individuals are at risk of asphyxiation which can cause serious injury or even death
- This removal of oxygen gas in the air we breathe makes having an oxygen depletion sensor not just useful, but essential to maintaining life.

11.3.6 Room Ventilation

Very high levels of ventilation are required to cope with spills of LN2. Experience has shown that ductwork should be avoided and multiple axial plate fans fitted at low level and directly on an external wall provide a cost effective solution. High level supply air grilles should be provided. Where cross flow ventilation is not possible, a false ceiling can be used as a supply plenum.

Three levels of ventilation are used:

- Continuous background at 10 ac/hr
- Occupancy medium at 25 ac/hr
- Oxygen depletion high at 40 ac/hr

12 Fuel Oil Systems

The fuel storage (35 second fuel oil also known as gas oil and red diesel) and supply system shall have sufficient fuel capacity to operate for 5 days continuously at 60% of the winter load.

- The fuel oil store shall comply with The Water Environment (Oil Storage) (Scotland) Regulations 2006
- All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, shall be tested by the manufacturers and be certified as compliant with the Directive
- The steel oil storage tanks shall be manufactured in accordance with BS 799-5. The oil storage tanks shall be installed in accordance with BS 799-5, BS 5410-2 and CIBSE Guide B. The tank(s) shall be Type J, rectangular tanks with a design head equivalent to a head of water not exceeding 0.5m above the top of the tank
- The fuel oil pumps shall be electrically driven positive displacement screw type for use with BS 2869: Part 2 Class D oils suitable for the viscosity and temperature of the grade of oil to be pumped. In addition, the provision of a manual pump is to be made. An integral pressure relief valve shall be fitted to positive displacement pumps. Anti-vibration mountings and flexible connections shall be provided as required
- A fire valve assembly shall be installed to shut off fuel supply to boilers in an emergency. The valve shall comply with BS 799-5
- A leak detection system between the oil fill point and the delivery of fuel oil to the boilers shall be provided. The leak detection shall comply with BS EN 13160. Any leak detection sensor system shall be linked to an integral alarm system, which shall activate an automatic shut-off system.

13 Trace Heating

Trace heating shall be used to maintain or raise the temperature of pipes and vessels applicable for internal and external frost protection and low temperature maintenance on heating lines, oil and chemical lines, sprinkler system mains and supply pipework. Including any exposed pipework or associated fitting either permanently or intermittently filled with water shall be trace heated, including vent and drain pipes.

All trace heating shall comply with BS EN 62395-1:2013: Electrical resistance trace heating systems for industrial and commercial applications. General and testing requirements.

Electrical heat tracing systems shall be provided with earth leakage protection (ground fault or RCD) devices for personnel and equipment protection.

Self-regulating tape shall be used, which must be suitable for any pipe material (copper, threaded pipes, stainless steel pipes, plastic pipes and composite metal pipes without restriction) and aluminium adhesive tape is required for use with plastic pipes.

14 Insulation

All building services insulation shall be specified and installed in accordance with BS 5422:2009: Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.

All insulation materials and finishes shall be inherently proofed against rotting, mould and fungal growth, attack by vermin, non-hygroscopic and, in all respects, suitable for continuous use throughout the range of operating temperatures and the environmental conditions indicated and in compliance with BS 5422 and 5970, as applicable. Insulation materials that contain or are manufactured using CFC or HCFC shall not be used.

All thermal insulating materials installed within buildings shall achieve Class 0 fire performance rating as defined in approved Document B, Appendix A12 of the Scottish Technical Building Standards and shall achieve a smoke generation rating of less than 5% when tested to BS 5111: Part 1. These ratings shall be obtained on un-faced insulating material.

Combustible facing materials shall not be more than 0.8mm thick and shall achieve a Class 1 Surface Spread of Flame when tested in accordance with BS 476: Part 7.

All thermal insulation materials and finishes must be free from substances, which in the event of fire would generate appreciable quantities of smoke, noxious and toxic fumes.

All ductwork and pipework shall be fitted with thermal insulation with pre-formed stucco aluminium casings, “hammerclad” type, within each plant room area up to 2m in height.

All external pipework and ductwork services shall be weather protected with a PIB insulation covering Polyisobutylene (PIB) to give exposed insulation and ductwork a tough weather and water-resistant sheet finish. The seams, overlaps and endlaps shall be solvent welded. The PIB sheet shall comply with BS 467 Part 7: Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products.

15 Testing and Commissioning

The Services Contractor shall apply following procedures to the installation:

- CIBSE Commissioning Codes Series
- BESA DW/144 – Specification for Sheet Metal Ductwork, Low, Medium & High Pressure/Velocity Air Systems
- BESA DW/145 - Guide to Good Practice for the Installation of Fire and Smoke Dampers
- BESA TR/6 - Guide to Good Practice - Site Pressure Testing of Pipework
- BESA TR/19 - Guide to Good Practice - Internal Cleanliness of Ventilation Systems
- BG29 Pre-commissioning of Pipework Systems

On completion of tests all systems shall be:

- Set to work;
- Fully regulated;
- Demonstrated to Design Team / UoE Development Engineer;
- Demonstrated to Estates Operation (Refer to Estates Design Guideline 19 for handover procedure).

The Contractor shall employ specialist Commissioning Engineers, with all necessary manpower and equipment, continuously on site during the commissioning works period and until completion of the commissioning. The commissioning specialist shall be responsible for preparation of integrated testing and commissioning programme. The programme shall allow for demonstration of all the systems.

Commissioning procedure will not be completed until witnessed by the Engineer and is accepted in writing. Seven days' notice of intention to commission any system shall be given.

The installation will only be deemed to have been successfully completed following a period of 7 days continuous, fully automatic operation (without malfunction, breakdown, out of tolerance performance).

Some commissioning checks may need to occur during maximum heating/ cooling condition. If the project is completed in summer, peak heating loads will be difficult to simulate. It may be necessary to defer some tests outside weather conditions to achieve useful results.

16 Identification of Plant and Equipment

For each services installed, upgraded or altered during works, the contractor shall provide full hydraulic schematics (glass frame, minimum size of A1.) The schematic drawings shall have reference for each main plant of equipment and associated valves, fire dampers along with corresponding schedules.

16.1 Plant

Identify all items of plant and equipment by permanently fixed identification labels as well as manufacturers' name plates.

Manufacture the labels from "Traffolyte" or similar material and print the name of the plant item, in 6mm high black infilled engraved lettering, on the upward facing side of the labels.

Ensure that all items of plant and equipment are provided with a securely fixed manufacturers' name plate, giving the reference number, size and model number, etc, of the plant as well as the following information as applicable:

- Speed in RPM, horse power, full load running, starting currents and voltage in the case of electrical plant
- Any other details necessary to allow the item of plant to be readily identified for the purposes of future replacement and spare parts.

16.2 Services Distribution

Identify all insulated and uninsulated pipework with P.V.C adhesive tape or similar, suitable for use with temperatures up to 125°C.

Ensure that all identification tapes give the following information:

- Colour coding, where applicable, in accordance with the recommendations of BS: 1710
- Name of service, whether flow or return, and an arrow indicating the direction of flow, all clearly legible against the background colour and with lettering not less than 6mm high
- Apply 300mm wide colour bands to each pipe at intervals of 15 metres maximum.

Place the identification tapes at all pipework junctions, at both sides of valves and items of plant at floor, ceiling and wall penetrations and at not less than 5m intervals on all straight pipe runs.

Identify all valves and cocks by permanently fixed labels, manufactured from 'Traffolyte' or similar material and engraved with markings and/or lettering in accordance with an agreed system of valve reference. The valve labels shall be complete with a corrosion resistant secure tag facility.

17 Design for Safe Operation and Maintenance

17.1 Maintenance Operations

- Safe access to all services equipment for inspection, maintenance and monitoring shall be provided. Care with respect to the capability to service the systems predominantly during normal working hours shall be accounted for, to ensure minimal disruption to the operation of the University
- Lifting beams appropriately located for a safe and efficient removal of parts
- All roof area plant rooms shall be provided with 'demountable' louvres, which are normally fixed, but facilitate access and egress of items of plant as required during the life of the facility. These shall be linked to the designated access and maintenance routes within each plant room
- The design proposals shall fully comply with these Guidelines in that all water and HVAC systems are designed to meet the requirement of HSE Approved Code of Practice (ACoP) and Guidance, L8, "Legionnaires disease; The control of legionella bacteria water systems." Submit details of all design risk assessments
- Maintenance access shall be from areas which are not accessible to either prisoners or security staff, to ensure a safe working environment.

17.2 Access and Maintenance Strategy

- The Designer shall submit a design stage Access and Maintenance Strategy to the UoE as part of their Stage 3 and Stage 4 proposals
- The Contractor shall submit an Access and Maintenance Strategy to the UoE as part of their as-built documentation
- Defined access routes shall be identified with routes for personnel and plant considered. Routes shall be delineated by robust walkway anti-slip matting system on flat roofs and with plant room areas highlighted by means of a hatched painted pattern on the plant room floors
- Major plant replacement shall be facilitated through designated routes and demountable louvre panels strategically located within each plant room or plant area
- A plant uplift/set down zone shall be defined in each external plant space, complete with a SWL notice
- The transportation of material and consumables shall be achieved without entering access controlled areas
- It should be noted that access to replace major plant items, which require the use of specialist lifting equipment external to the respective building, shall be highlighted in the Access and Maintenance Strategy.

18 Mechanical Engineering Services Working Group (MESWG)

The MESWG shall keep under review and update the Mechanical Engineering Services Design Guidelines (Assets & Standards) on an annual basis as a minimum in readiness for the January in each calendar year. Please see Appendix H.

APPENDICES

Appendix A Schedule of Approved Equipment

Item	Manufacturer	Description

The design team should populate and provide the above schedule of proposed manufacturers.

All manufacturers are only provided on ‘equal and approved’ basis for the reasons of competitive tender.

All products shall be ‘open source’ allowing competitive maintenance tender and part replacement.

Appendix B Schedule of Approved CDP Contractors

Item	Specialist	Description

The design team should populate and provide the above schedule of proposed trade contractors. All manufacturers are only provided on ‘equal and approved’ basis for the reasons of competitive tender.

All products shall be ‘open source’ allowing competitive maintenance tender and part replacement.

Appendix C Design Guidelines

Please find the most current version of the University Of Edinburgh Estates Department, Design Guidelines and Relevant Policies here:

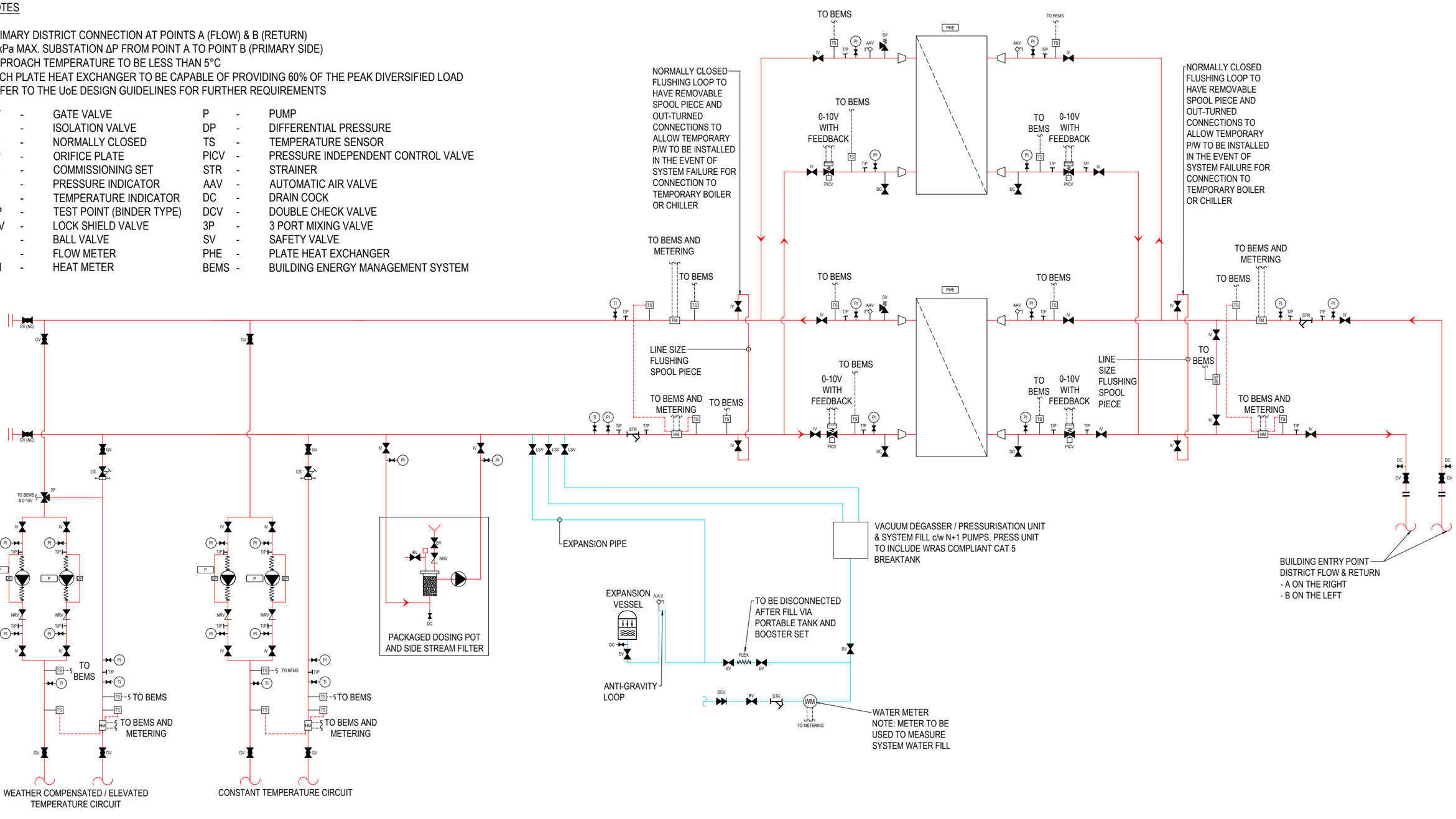
https://www.ed.ac.uk/estates/about-us/design-guidelines/engineering-design

Appendix D Heat Station

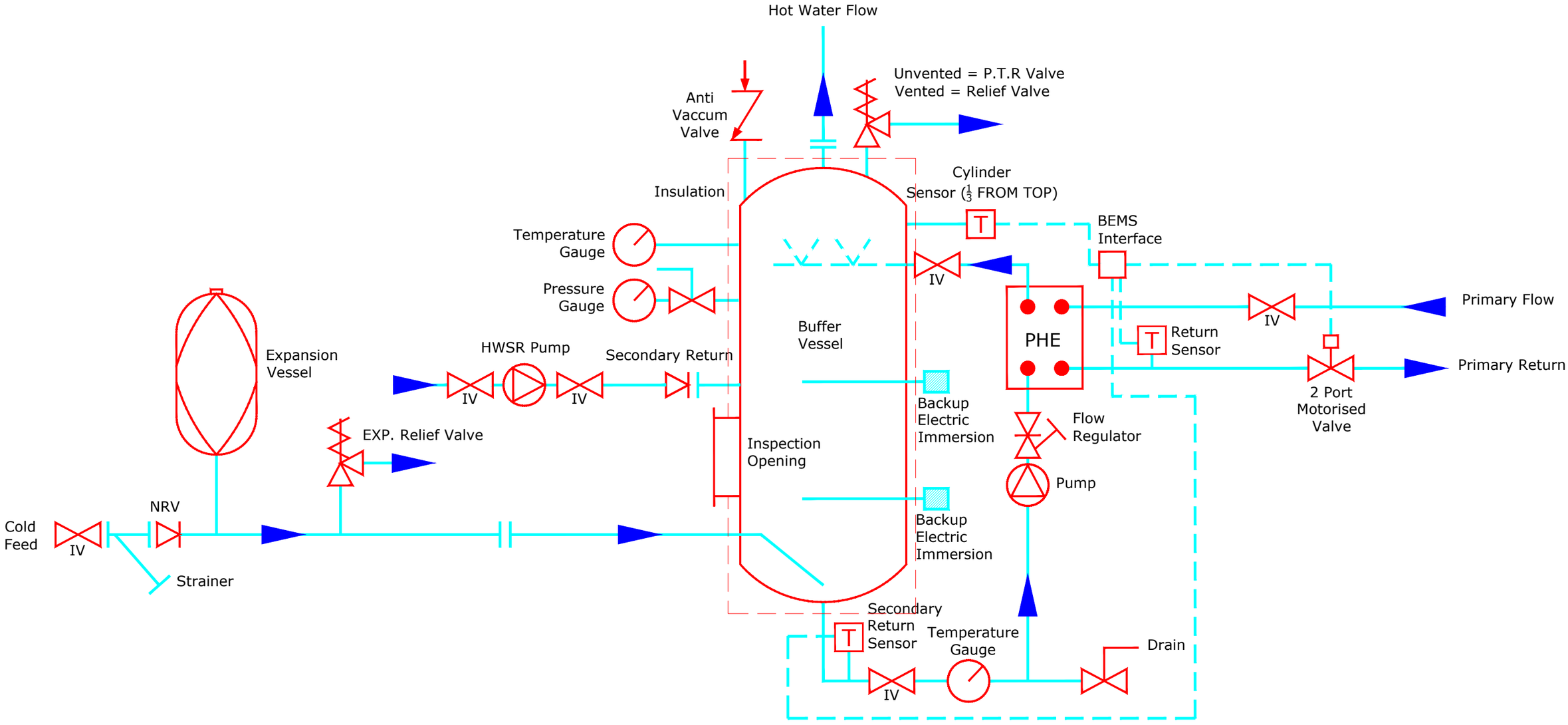
NOTES

PRIMARY DISTRICT CONNECTION AT POINTS A (FLOW) & B (RETURN)
60kPa MAX. SUBSTATION ΔP FROM POINT A TO POINT B (PRIMARY SIDE)
APPROACH TEMPERATURE TO BE LESS THAN 5°C
EACH PLATE HEAT EXCHANGER TO BE CAPABLE OF PROVIDING 60% OF THE PEAK DIVERSIFIED LOAD
REFER TO THE UoE DESIGN GUIDELINES FOR FURTHER REQUIREMENTS

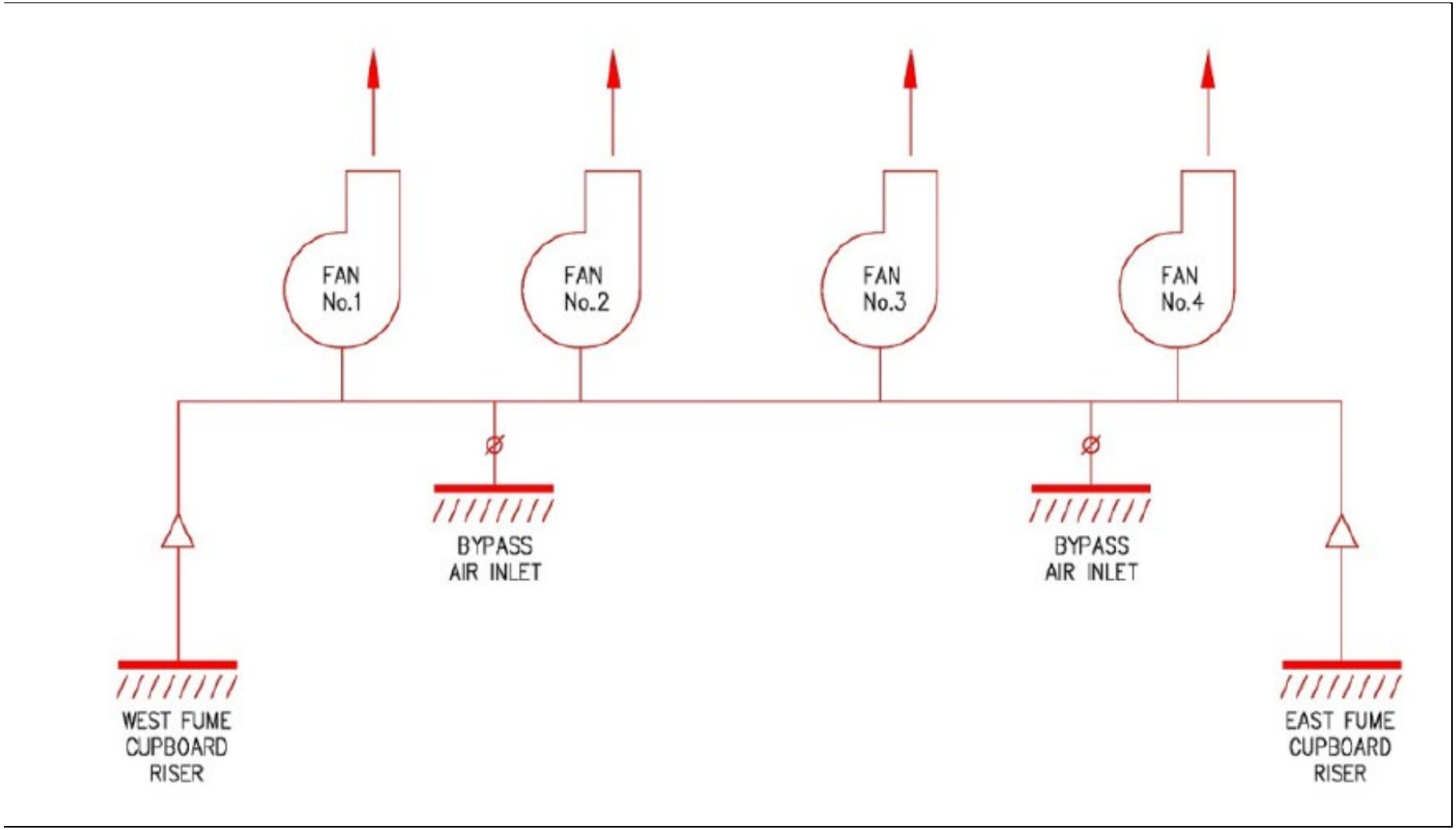
GV	-	GATE VALVE	P	-	PUMP
IV	-	ISOLATION VALVE	DP	-	DIFFERENTIAL PRESSURE
NC	-	NORMALLY CLOSED	TS	-	TEMPERATURE SENSOR
OP	-	ORIFICE PLATE	PICV	-	PRESSURE INDEPENDENT CONTROL VALVE
CS	-	COMMISSIONING SET	STR	-	STRAINER
PI	-	PRESSURE INDICATOR	AAV	-	AUTOMATIC AIR VALVE
TI	-	TEMPERATURE INDICATOR	DC	-	DRAIN COCK
T/P	-	TEST POINT (BINDER TYPE)	DCV	-	DOUBLE CHECK VALVE
LSV	-	LOCK SHIELD VALVE	3P	-	3 PORT MIXING VALVE
BV	-	BALL VALVE	SV	-	SAFETY VALVE
FM	-	FLOW METER	PHE	-	PLATE HEAT EXCHANGER
HM	-	HEAT METER	BEMS	-	BUILDING ENERGY MANAGEMENT SYSTEM



Appendix E Hot Water Service


Hot Water Flow
Anti
Vaccum
Valve
Unvented = P.T.R Valve
Vented = Relief Valve
Insulation
Cylinder
Sensor (1/3 FROM TOP)
T
BEMS
Interface
Temperature
Gauge
Pressure
Gauge
IV
PHE
IV
Primary Flow
Buffer
Vessel
T
Return
Sensor
Expansion
Vessel
HWSR Pump
Secondary Return
IV
IV
IV
2 Port
Motorised
Valve
Primary Return
Backup
Electric
Immersion
Flow
Regulator
EXP. Relief Valve
Inspection
Opening
Pump
NRV
Cold
Feed
IV
Backup
Electric
Immersion
Strainer
Secondary
Return
Sensor
T
Temperature
Gauge
Drain
IV

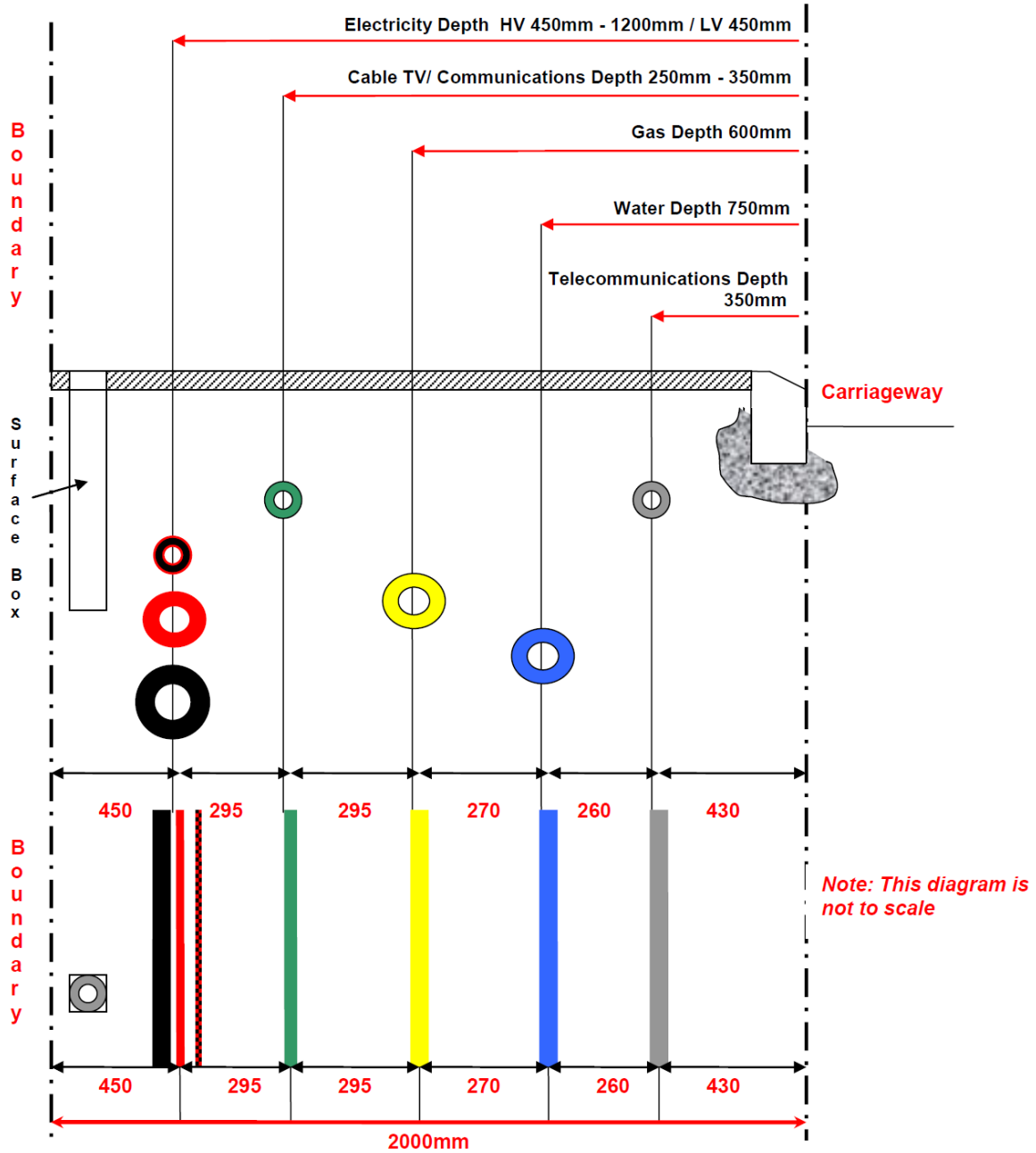
Appendix F Fume Cupboard Extract Arrangement



Appendix G NJUG Guidelines on the Positioning of Underground Apparatus

FIGURE 1 - Recommended Positioning of Utility Apparatus in a 2 metre Footway

Note – the same positioning should apply in the carriageway/service strip (if safe and practical to do so) where a development has no footway(s) available for services and/or the boundary of the property is on the carriageway (please refer to minimum depths in carriageways). For further advice please contact the asset owner.



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Appendix H Mechanical Engineering Services Working Group

TERMS OF REFERENCE

Purpose:

The Mechanical Engineering Working Group (MESWG) shall keep under review and update the Mechanical Engineering Services Design Guidelines (Assets & Standards) on an annual basis as a minimum in readiness for the January in each calendar year.

The MESWG will ensure that: suitable, sufficient, current and relevant Mechanical Engineering Services Design Guidelines information is readily available to Design Teams and Contractors undertaking project works on behalf of the University of Edinburgh.

The MESWG must ensure that Mechanical Engineering Services Design Guidelines upholds the Health and Safety arrangements in respect of Mechanical Engineering Services for the University Estate, in order to safeguard all in its community including students, staff, contractors, partners and visitors.

The MESWG will promote the application of Mechanical Engineering Services Design Guidelines with the respective Project Manager.

The MESWG will respond in a timely manner to comments and feedback via the Building Services Group Manager in respect of accuracy and emphasis of content of the guidelines.

The MESWG will endeavour to seek out best practice from other Universities with regard to Mechanical Engineering Services Design Guideline matters and where applicable, to incorporate these into University Mechanical Engineering Services Design Guidelines, Mechanical Engineering Services related policies and procedures, etc, and share.

The MESWG will discuss legislative, policy and operational effectiveness of the Mechanical Engineering Services Design Guidelines and review the impact upon the University of Edinburgh Estate and its communities.

The MESWG will support the Health and Safety communications strategy with key stakeholders, e.g. Estates Department, Design Teams, Contractors, Student Services, etc. This includes issues such as; building design, environments, passive and active Mechanical Engineering Services management and control measures, etc.

The Mechanical Engineering Services Working Group will escalate unresolved matters associated with operational effectiveness of the Mechanical Engineering Services Design Guidelines on the University Estates and its communities to the Director of Estates Operations.

The MESWG will annually review of Terms of Reference of the Mechanical Engineering Services Working Group.

The MESWG will submit updated versions for the Mechanical Engineering Services Design Guidelines for consideration and approval to the Estates Management Group.

MESWG Membership:

Building Services Engineer – Mechanical (Chair)

UoE Development Engineer – Mechanical (Deputy Chair)

Building Services Engineer (Mechanical)

Estates Health and Safety Manager

Specialist attendees by invitation

Quorum: 3

Frequency of Meetings: 2 meetings per year

MESWG Standard Agenda Items:

Welcome, introductions and apologies

Review of previous minutes for accuracy

Update of actions from last meeting and feedback

New matters and issues for discussion, update and version control

Actions and matters to be escalated to the Director of Estates Operations

Any other business

Date and time of next meeting

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Estates Department

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