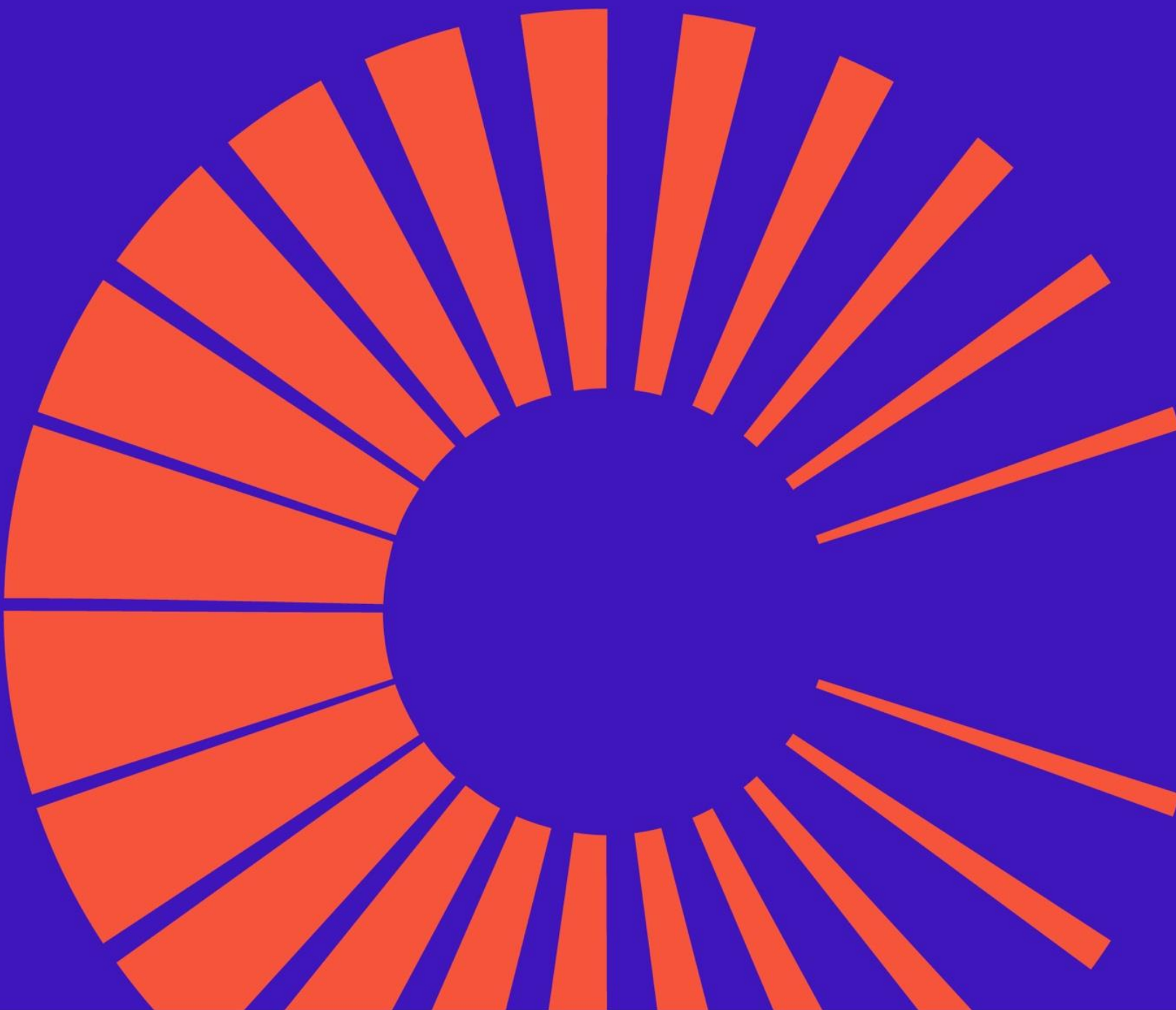


University Academy Long Sutton

DEIR072 - Building Services Strategy Report
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1.0 Introduction

This report has been compiled by Chord Consult to provide an overview of the particular mechanical and electrical services proposed for the University Academy Long Sutton.

All engineering services installations shall be developed in accordance with all current Building Regulations, the Non-Domestic Building Services Compliance Guide, British Standards, CIBSE Guidelines, The Equality Act and the latest edition of the IET Wiring Regulations

It is also intended that this report will function as confirmation of the Client's brief for the mechanical and electrical services, such that principles and outline proposals are informed and agreed.

2.0 Mechanical & Electrical Design Criteria

The new development will be designed to adopt both passive and active measures to provide a comfortable, vibrant environment conducive to productive learning and working at all times.

The engineering services shall be designed to comply with Department for Education (DfE) suite of briefing documents, including:

- DfE Employer's Requirements - Part A – General Conditions
- Output Specification - Generic Design Brief (GDB)
- Output Specification - All Technical Annexes
- Output Specification - School-Specific Brief
- Output Specification Schedule of Accommodation Area Data Sheets

The Output Specification (and other project specific briefing documents) shall take precedence where a contradiction occurs; however, the supporting documents including the good practice guidance within the Building Bulletins shall be adhered to where appropriate to do so. Particular attention will be given to the following specific current guidance documentation:

- BB93 Acoustic Design in Schools (updated) / DfE PSBP – Acoustic Design of Schools
- BB100 Design for Fire Safety in Schools
- BB101 Ventilation of School Buildings
- BB102 Designing for disabled children and children with special educational needs.
- BB104 Area guidelines for SEND and alternative provision.
- CLEAPSS G9 - Fume Cupboards in Schools
- CLEAPSS Guidance Document L225 - Managing Risk Assessment in Design & Technology

The following design, installation and general guidance standards are to be incorporated within the mechanical and electrical services of the project: -

- Secured by Design
- Current Building Regulations.
- HM Government – Non-Domestic Building Services Compliance Guide
- The Clean Air Act.
- Health and Safety at Work Act and associated regulations including the Electricity at Work Regulations, COSHH and the Prevention of Control of Legionella.
- Approved Code of Practice L8 'The control of legionella bacteria in water systems'
- CIBSE KS09 - Commissioning Variable Flow Pipework Systems and the CIBSE Commissioning Codes.
- BSRIA commissioning codes.
- HSE GS 4 - Safety in Pressure Testing

- HSE Catering Information Sheet 10 & 23
- HSE L56 - Gas Safety (Installation and Use)
- HSG 258 - Controlling Airborne Contaminants at Work
- Design to fully meet the requirements of the local Environmental Health Officer, Fire Officer and Building Control Officer. These requirements being incorporated over and above any minimum standards given in this document.
- All relevant British Standards. Any references to BSI documents in this tender are to the version and amendments listed in the British Standard Catalogue current at the date of tender.
- IGEN/UP/2: Installation Pipework on Industrial and Commercial Premises.
- IGEN UP/3: Gas Fuelled Spark Ignition and Dual Fuel Engines.
- IGEN/UP/10: Installation of Flued Gas Appliances in Industrial and Commercial Premises.
- IGEN/UP/11: Gas Installations in Educational Establishments.
- IGEN/UP/16 - Design for Natural Gas Installations on Industrial and Commercial Premises With Respect to Hazardous Area Classification and Preparation of Risk Assessments.
- The Gas Safety Regulations.
- IGEN/UP/19: The Design, Specification and Application of Interlock Devices Used Within Commercial and Industrial Applications Including Catering.
- British Compressed Gases Association – Code of Practice 44 The storage of gas cylinders
- BESA DW/144 - Specification for Sheet Metal Ductwork.
- BESA DW/172 - Specification for Kitchen Ventilation Systems.
- BESA TR/19 - Guide to Good Practice. Internal Cleanliness of Ventilation Systems.
- All relevant CIBSE Guides.
- All relevant CIBSE Technical Memorandum.
- ASHRAE 62.1:2013 - The Standards for Ventilation and Indoor Air Quality.
- ASHRAE Handbook 2015.
- COSHH - Control of Substances Hazardous to Health Regulations 2002.
- The Building Regulations: Access to and use of Buildings, Approved Document Part M: 2013 Edition.
- IoA/ANC - Acoustics of Schools: A Design Guide 2015.
- The design shall meet the criteria laid down within the current edition of the IET Wiring Regulations i.e. BS7671.
- Construction Design and Management Regulations 2015.
- Structural general arrangement and sections.
- All requirements of the local Utility Companies.
- Water regulations.
- WRAS regulations.

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2.1 Approved Document L2A: Compliance & Energy Performance Certificate

An initial BRUKL calculation shall be undertaken at the next stage of the design process, however, achieving compliance with the new AD Part L 2021 requirements will be straightforward because of the DfE's S21 requirements to achieve net zero carbon in operation (NZCiO) at handover.

For further details of the NZCiO design solution, please refer to the DEIR 079 Energy Strategy Report.

As the design develops, it is the duty of the Mechanical and Electrical Sub-contractor to model the building to reflect the detailed design, ensure Building Regulations compliance, amend the design as required (and liaising with other members of the design team where changes are necessary to the architectural or electrical design etc) and to submit the "As Designed" and "As Built" compliance certificates and energy performance certificates.

2.2 BREEAM Assessment

BREEAM is not a requirement on this project.

2.3 Climate Based Daylight Modelling

The Output Specification requires the building design to be assessed using climate-based daylight modelling to demonstrate compliance with the OS in terms Daylight Autonomy (DA), Useful Daylight Index (UDI) and control of glare. The standard Configure classroom has been modelled in a variety of locations, orientations and construction positions (unshaded, facing a courtyard etc). For further information on the Climate Based Daylight Modelling assessment for the project, please refer the Arup Report.

2.4 External Design Conditions

The contractor shall select suitable CIBSE approved weather data libraries for the site location.

2.5 Internal Design Conditions

It should be noted that the Winter Internal Conditions outlined in the table below are taken from the DfE Output Specification-Technical Annex 2F. The tables show the normal maintained operative temperature which should be used for design conditions whilst maintaining the maximum stated temperatures for the heating season.

Table 2.5A Type of space/activity	Normal maintained operative temperature - °C	Maximum operative temperature during the heating system during at maximum occupancy - °C
Stores not normally occupied	5°C	N/A
Areas where there is a higher than normal level of physical activity (such as sports halls) and sleeping accommodation	17°C	23°C

Toilets, circulation spaces and storerooms that are normally occupied	17°C	24°C
Kitchen preparation areas	20°C	N/A
Spaces with normal level of activity, including all basic teaching areas (including practical and ICT-rich spaces), study and social space, learning resources, halls used for exams, admin and staff areas, prep rooms	20°C	25°C
Spaces with less than normal level of activity or clothing, including sick, MI or therapy rooms, changing rooms and gymnasia and dance and activity studios	21°C	26°C
Special schools and Designated Units, pupils have physical difficulties or profound and multiple learning difficulties	23°C	25°C
Where Pupils or adults may be wet and partially clothed for a significant length of time, such as swimming pools	23°C in changing rooms and no more than 1°C above or below that of the water temperature in pool halls subject to a maximum of 30°C	28°C in changing rooms and no more than 1°C above that of the water temperature subject to a maximum of 30°C in pool halls
Where young children or those with physical disabilities may be wet or partially clothed for a significant length of time. Rapidity of air movement can lead to chilling by evaporation and to compensate, a higher design temperature may be required	25°C The air speed in the environments should be as low as possible and not exceed 0.1m/s at 25°C	30°C
Note: SEND pupils can be very sensitive to temperature and it may be necessary to adjust the normal operative temperature and maximum temperature in the heating season depending on the needs of the pupils.		

The contractor shall also consult the area data sheets for the specific school design as there may be discrepancies between the sets of information.

The internal lighting design conditions shall be designed in accordance with: -

- Project briefing documents including the Output Specification, Project Area Data Sheets, School Specific Brief.
- CIBSE Lighting Guide 5 (LG5): Lighting for Education.
- CIBSE Lighting Guide 7 (LG7): Office Lighting.
- BS EN 12464-1: Lighting for the Internal Workplaces.
- BS 5266 -1: 2011 'Emergency lighting – Part 1: Code of practice for the emergency lighting of premises'.
- CIBSE Lighting Guide 12 (LG12) Emergency lighting design guide.
- BS EN 12464-2: 'Lighting for Exterior Workplaces.
- BS 5489 Code of practice for the design of road lighting.
- ILP GN01 Guidance.
- Building Regulations Part L

2.6 Maximum Summertime Temperatures and Heat Gains

The building shall be designed to meet the requirements of Technical Annex 2F following the overheating method as set out within CIBSE Technical Memorandum 52 – The Limits of Thermal Comfort: avoiding overheating in European Buildings. Initial thermal modelling has been conducted to demonstrate compliance at concept design stage – the CIBSE DSY1 2080 50th percentile weather file has been used, please refer to DEIR 080 Environmental Strategy Report for further information. The contractor shall ensure that the inputs of initial overheating analysis are adhered to. If any deviation is found, then the contractor shall ensure that the requirements of TM52 are maintained.

For the equipment gains, the DfE's internal gains calculator tool will be used with reference to Table A.2 from CIBSE Technical Memorandum 37. The internal gains will be based and profiled on the information provided by the school or contained within the School Specific Brief.

Occupancy heat gains will be in-line with the ADS with space appropriate profiles applied.

Lighting heat gains will be to reflect the designed artificial lighting system.

The contractor should also be aware of the limitations of the use of mechanical cooling whereby mechanical cooling cannot be used within teaching areas where the equipment gains are less than 10 W/m², or in the case of practical spaces where the equipment gains are less than 25 W/m².

2.7 Local Thermal Discomfort Caused by Draughts

The ventilation within occupied zones shall be designed to be compliant with the requirements as set out within Technical Annex 2F Section 10.4.

Natural ventilation shall only be used where it can be proved to be fully compliant with the cold draught criteria, achieve overheating compliance and be acceptable for acoustics and air quality compliance.

Forced draught systems, where the driving force for supply air is a fan, shall be designed to meet the values given within Technical Annex 2F Section 10.4.

The comfort categories for cold draughts for different spaces and activities given in TA2F Table 10.3 shall be used with Table 10.4.

2.8 Lighting Lux Levels

Internal lighting design conditions shall be as those detailed in the Project Area Data Sheets and as indicated on the electrical services lighting lux level and controls philosophy drawings provided.

Where rooms are used for dual purposes, the lighting design will be based on the majority hourly use of the room, even if the minority hourly use requires an elevated lighting level. This approach is inferred within LG5, as the elevated illuminance could be misused when the space is used for the majority hourly use.

The external lighting will be provided in accordance with CIBSE Lighting Guide 5 and building control for the external areas including building amenity, pedestrian walkways, car parks, refuse collection and designated cycle storage.

2.9 Light Source

All internal and external light fittings shall utilise the most current technology from the Light Emitting Diodes (LED's) industry in order to provide a compliant scheme whilst driving down energy usage and meet the targets set out.

2.10 Lighting Controls

The majority of artificially illuminated spaces will be provided with automatic lighting controls to minimise energy consumption and to maintain a common switching arrangement in frequently occupied spaces. the exception being areas that present an immediate danger when lights automatically switch.

Unoccupied areas (WC's and hygiene suites, circulation spaces, storerooms, etc.) shall be provided with presence detection (automatically switching lights on/off).

Occupied areas (offices, staffrooms, classrooms etc.) shall be provided with absence detection (manual on / auto off).

In owned, daylit spaces automatic dimming (daylight dimming) is provided to further reduce the energy usage.

Please refer to the electrical services lighting lux levels and controls philosophy drawings for all automatic lighting controls proposals.

2.11 Lighting Efficacy

Approved Document L Volume 2 requires general lighting to have either.

- An average luminaire efficacy of 95 luminaire lumens per circuit-watt or.
- A Lighting Energy Numeric Indicator (LENI) method, following Appendix B of Approved Document L Volume 2.

We recognise OS Technical Annex 2H and the need for maximising energy efficient lighting systems (2.2.3.3 e), as a consequence the type of lights we propose for the fixed lighting systems have been selected to give a minimum initial luminaire efficacy of 78-80 lumens per circuit watt in low use areas such as WC's, with the majority of lighting within occupied areas typically exceeding a minimum of 100 lumens/circuit watt to bring the average above 95 luminaire lumens. This excludes track-mounted lights and emergency lighting.

The use of low energy fittings also provides low heat gains within the associated rooms reducing the energy expended in summertime cooling.

2.12 Uniformity Ratio

The uniformity ratio (minimum/average maintained illuminance) of the artificial lighting in teaching rooms/spaces shall be targeted not to be less than 0.6 over the task area.

2.13 Cylindrical Illuminance

The cylindrical illuminance within teaching spaces is recommended by CIBSE Guidance LG5 to achieve be a minimum of 150Lux at a height of 1.2Mtrs.

Where light pastel colours are used on the ceilings and walls (as generally proposed) the final lighting schemes will provide the cylindrical illuminance in accordance with The Output Specification.

2.14 Emergency Lighting

Emergency lighting shall be provided to the school in accordance with the fire officer's requirements, Building Regulations, BS 5266 (British Standard for Emergency Lighting) and LG12 – CIBSE emergency lighting guide.

Generally the emergency lighting shall make use of standard fittings converted by the manufactures for emergency use. This provides the most aesthetically pleasing solution.

2.15 Surface Reflectance's

For any artificial lighting analysis, where light reflectance values (LRV) are not known, the following standard LRV's shall be assumed for calculation purposes.

At this stage, LRV's for the following areas are known and shall be utilised in the artificial lighting analysis. These shall be confirmed by the architect during the detailed design stage.

Area	Light Reflectance Value (LRV)		
	Ceiling %	Walls %	Floor %
General Classrooms (with 1/3 suspended ceiling and 2/3 painted soffit).	82.5	60	20

Rooms with full suspended ceilings & carpets – music classrooms, drama, offices, corridors etc.	85	60	20
Rooms with full suspended ceilings, with latex / lino flooring - Food Rooms resistant materials, dining, science labs, main hall etc.	85	60	24
Note: the reflectance levels used for the internal lighting calculations differ to the daylighting analysis, this is due to the daylight software not having an allowance for Room Surface Maintenance Factors (allowance made for the areas being cleaned etc.).			

2.16 Glazing Transmission Values

The following table indicates the optimised glazing performance for the Standard Configure design solution for both solar control (g-value) and visible light transmittance, Lt-value:

Component	U value (W/m2.k)	Solar g value (BS EN 410)	Light trans (%)
Windows and glazed doors – North Elevation	1.15	0.36-0.59	69-71
Windows and glazed doors – Other Elevations	1.15	0.36-0.39	67-69
Horizontal Roof Lights - Clear	2.1 (tbc)	0.37	65-70
Horizontal Roof Lights - Opaque	2.1 (tbc)	0.37	65-70

Note: lower g-values may be required in localised rooms to achieve overheating compliance.

2.17 Plantroom Strategy

2.17.1 Heat Generation

A new low-temperature hot water heating (LTHW) installation shall be provided comprising an Air Source Heat Pump (ASHP) solution which shall be located in the external plantroom behind the building. A feed to CT pipework will run to the main building to serve all heat emitters, localised plantrooms are positioned where domestic hot water shall be generated locally to serve zones. The external plantroom is located to the rear of the building with the ASHP situated next to the plantroom.

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Local plantrooms shall be located throughout the building within the vicinity of areas with larger domestic hot water loads required, such as WC block, Kitchen, Food Room etc. where smaller internal ASHP arrangements shall be provided to serve dedicated hot water cylinders to serve locally adjacent spaces with domestic hot water requirements.

Incoming services shall enter the building via dedicated mechanical and electrical plant areas on the façade to facilitate coordination of the rising services from ground.

2.18 Main Service Distribution

Primary distribution routes for all services through the building have been considered and shall be provided to ensure suitable access for maintenance, inspection and cleaning – please refer to the service distribution drawings for initial sizes and specific routes.

2.18.1 Riser Distribution Strategy

Risers shall be provided to allow required distribution of all services throughout the building. Local ventilation risers shall be present to the central WC cores to route ductwork up through each storey from mechanical ventilation unit to all outlets on both room and air side. Ventilation risers shall also be provided for mechanical ventilation to kitchen and any landlocked areas requiring a route to outside where no viable option is present to route fans to the façade.

Low temperature hot water flow and return pipework services from mechanical incoming services plantroom at ground floor and shall utilise risers to route up through the building to serve all heating emitters including Air Handling Unit heating coils, Heat Recovery Unit heating coils and radiators.

Space allowance has also been made within the design for location of gas services pipework to science labs and siphonic drainage.

2.18.2 Corridor Distribution Strategy

Main corridor distribution routes will be kept to a minimum via the use of local plantroom design where domestic water services have been zoned to minimise heat losses of the system and unwanted heat gains in transient spaces.

Boosted cold water shall run in general corridors to serve outlets and domestic hot water plantrooms within local zones serving hot water consuming areas of the building (i.e. central WC blocks/Kitchen).

Category 5 pipework shall be provided to minimise risk of backflow of any harmful substances into potable water systems. The category 5 distribution shall run along main corridor routes to serve any external bib taps and science laboratory outlets from local plantrooms where category 5 break tanks shall be located.

3.0 Enabling and Utility Infrastructure Works

New utility services connections shall be provided for the new development. The infrastructure supplies, for the new school building shall be: -

- Natural gas service (to science spaces only)
- Mains cold water service (domestic use and firefighting purposes where required)
- Incoming electrical service
- Incoming communications

Initial loading calculations have been utilised to assess the utility works for the project. It shall be the responsibility of the Contractor to check and confirm the proposed supply sizes and to manage the new utility supplies installation/coordination as the detailed design progresses.

The proposed utility philosophy drawing indicates the proposed connections to the site boundary, external ductwork and building intake locations.

Please refer to the DEIR 079 Energy Strategy Report for a concise summary of the proposed works to the external services for this project.

3.1 Gas Services

A new buried PE low pressure gas supply shall be taken from the local gas utility infrastructure within Cop Lane to supply the new school bunsen burners via a gas meter enclosure located in the soft landscape before the car park. From this point a new buried low pressure gas supply will be taken to the main building intake.

Due to the low energy usage aspirations of the project, the intention was that the building will not utilise any gas, instead all kitchen equipment will be electric and the building will be heated via a range of onsite renewables such as air source heat pumps. However, through the experience of similar discussions on other DfE projects, it has been confirmed that Science cannot be delivered using an electric Bunsen burner and consequently a gas supply is needed for the building.

The gas supply is sized to meet the peak demand of the Bunsen burners as shown in the table below – the option of applying diversity shall be considered at the next stage: -

Gas Supply Ref	Peak Flow Estimate
Science Labs Allowance	10.1m ³ /hr
Total	10.1m³/hr

3.2 Water Utility Services

A new potable utility water connection shall be provided for the new building. This shall be taken from the nearby public main in Cop Lane and a new primary meter shall be installed just within the boundary to the site.

The new building shall have cold water storage (within separate tank room at top of stairs) sized at 5 litres/occupant however to increase turnover and help prevent rising storage temperatures in summer, the volume of the system of pipework will be subtracted from the storage amount. The tank room has been proposed at roof level to reduce energy consumption therefore it is assumed the water pressure on site is sufficient and shall not require a booster however a small booster pump on the incoming main has been included for as an insurance measure. A new single connection shall be provided to serve the storage refill rates required to new school building.

The estimated peak mains cold water flow for the new supply is as follows: -

Water Supply Ref	Potable Peak Flow
Potable Storage Tank Refill	2.29 l/s
Catering Kitchen Allowance	0.75 l/s
Cat 5 Tank Refill	0.25 l/s
Total	3.29 l/s

3.3 Fire Hydrant

A new fire hydrant is proposed to be located within the site boundary to ensure the new build and has the necessary fire hydrant coverage. This hydrant meets the requirements of Part B of the Building Regulations and BB100, falling within 100m of a means of entrance to the new building and temporary classrooms. At this stage we are awaiting confirmation of the available flow rate at this hydrant from the network provider. Please refer to the proposed external services drawings for further details.

3.4 Electric Utility Services- New Connections

3.4.1 Utilities & Retained Building Integration Strategy

References are made throughout these documents to the Clients briefing requirements and initial surveys, most notably: -

- The DfE Output Specification (OS) and associated annexes
- DfE provided below ground services scan.

Please note that the information on the incoming new loads is also repeated within the Energy Strategy Report.

3.4.2 Existing Arrangement

Desktop utility records from the local Distribution Network Operator (DNO) and below ground topographical survey drawings have indicted the locations and routes of utility supplies across the proposed school site.

See drawing SRP1155-CHD-ZZ-ZZ-D-Z-9000 for existing site services.

The existing below ground topographical survey shows services across the site to all buildings, the following existing services are identified and need further investigation:

- LV
- BT
- Gas
- Unknown
- HV
- Buried water has not been shown on the TOPO and further investigation is required.

Refer to drawing SRP1155-CHD-ZZ-ZZ-D-Z-9001 for envisioned works associated with the services :

3.4.3 Proposed incoming solution.

Early-stage communication has been undertaken with the local DNO – UK Power Network and a budget quotation will be requested for the new supply proposal.

It is proposed the new school building will have a single dedicated Low Voltage TPN power supply from a new DNO owned substation.

The new substation has been integrated into the landscape architects proposed site layout. The substation shall be sited on a 4m x 4m (minimum) concrete plinth, unobtrusive and convenient location which allows for 24 hour access by the DNO.

The substation has not been located in line with DfE School output specification – Generic design brief located on the site boundary, this is due to the load of the building and maximum permitted cables distance from the substation at this high load and the building position, the proposed substation position has been shown on the external drawing. The position of the substation is to be agreed with the DNO, further discussion will be had once the budget quotation has been received).

Due to the substation being remote from the building electrical intake room an additional external switch room is proposed adjacent the substation this will house the DNOs cut-out unit and clients meter, the electrical sub-contractor shall provide LV cabling from this location to the electrical switch room.

Careful consideration has been taken for the location of the substation, electrical switch room and cable trench routes. unobtrusive location of on-site substation(s) as well as 24 hour access and economical routes of cables trenches.

3.4.4 Proposed incoming solution Nursery Buildings

It is envisioned the Nursery buildings will require a new DNO supply within each building as they are currently fed from the school.

For Budget purposes we have allowed for 2No 100A single phase supplies, the load is to be confirmed via a survey for the next stage.

The existing library supply is to remain.

Building Services Strategy Report

3.4.5 Predicted Electrical Loads

The new electrical supply will be used to feed the new main teaching block LV panel, An external LV switch room is needed due to the distance the substation is from the building as indicated on the LV schematic and proposed external services drawing.

The table below highlights the proposed incoming electrical supply maximum demand and spare future capacity for the proposed new building.

Electrical Supply Ref – New School	Electrical Load (maximum Demand)
Proposed new building (Proposed kitchen load allowance - included within proposed new building load above)	520kVA (100 kVA)
Spare capacity (10%)	54 kVA
Total (maximum demand)	550 kVA

This will be reviewed again at the next stage.

Electrical Supply Ref – Nursery Buildings – new DNO supplies	Electrical Load (maximum Demand)
Nursery building 1 (Load to be confirmed via survey)	23kVA
Nursery building 2 (Load to be confirmed via survey)	23kVA

This will be reviewed again at the next stage and updated following a survey.

3.4.6 Energy Supplier

The Electrical Sub-Contractor shall request the name of the preferred energy supplier for the site from the school via the Principal Contractor. On confirmation of the preferred energy supplier the Electrical Sub-Contractor shall request and fill in all sections of the application form (with the exception of payment details) and issue same to the School via the Principal Contractor.

The installation of the energy meter(s) shall be managed and co-ordinated by the Electrical Sub-Contractor.

3.5 Telecommunications Utility Services

3.5.1 Incoming Communications – New Connections

The ITC Consultant has liaised with the school during the preliminary stages and gained an understanding of the particular requirements regarding the required IT infrastructure associated with this development.

The necessary external / internal ducts and draw-in pits shall be provided, as per utility company's requirements. External ducts shall be installed from the proposed main building to the site boundary in locations agreed with the utility company for the new telecommunications services.

New connections shall be considered by the Contractor for providing new telecommunications services to the new development from existing services local to the development. Refer to the external services drawing for details of the external duct arrangements.

The Contractor shall allow to fully liaise with the chosen telecommunications service provider in respect of incoming supply cables, ducting, external chambers etc. and to coordinate as required. Final connections shall be made by the telecommunications service provider's engineers.

The Contractor shall be responsible for the provision of all necessary telephone wiring to serve the new building. The Contractor shall identify the chosen provider. On completion of the works, the Contractor shall arrange for the telephone connections to be made and will pay the appropriate standard connection charges. At handover, the Client shall adopt the provider and associated billing arrangement.



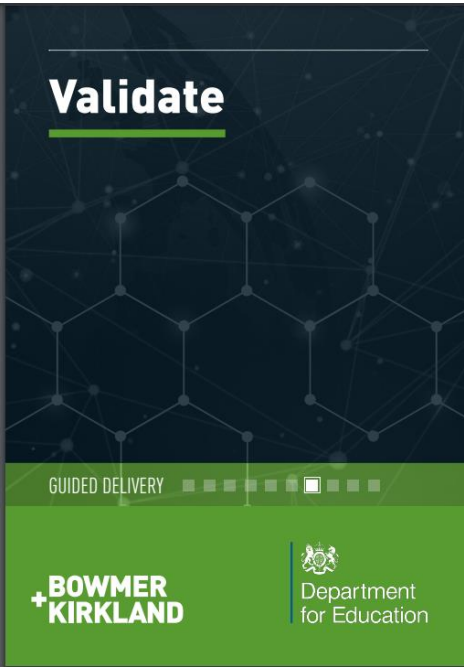
4.0 Energy Metering & Building Performance Evaluation

The building will contain a Building Energy Management System (BEMS) to control the major items of plant. The BEMS system will also monitor all major items of plant highlighting any faults in operation. The BEMS will be web-enabled to allow remote access to all data for remote monitoring purposes via the platform. The proposed design will include automatic monitoring and reporting (AMR) of data from all the buildings energy meters to ensure any excessive consumption is quickly identified and dealt with. The automatic metering will utilise the iSERV methodology for uploading the consumption data to the Carbon Buzz benchmarking website for comparison to enable the school to quickly appraise their in-use energy consumption against other similar facilities and identify any cases of unusual consumption.

The proposed M&E systems have been kept as simple as possible allowing a relatively simple metering strategy, as encouraged by the OS. However, the metering strategy is sufficiently robust to be able to support the Building Performance Assessments (BPE) post-handover – please see the BPE section for further details.

To ensure the requirements set out in Annex 2I of the Output Specification and the BPE requirements can be met and NZCiO can be proven, a B+K specific standard known as ‘Validate’ has been developed to standardise the approach to metering (and sensors) including, some of items controlled by the standard are: -

- What end use systems and services need metering
- Type of meter and data output
- How meters (and sensors) are named and tagged
- The process for commissioning of the systems including documentation.
- Soak test delivery
- Post handover requirements including Measurement and Verification plans.

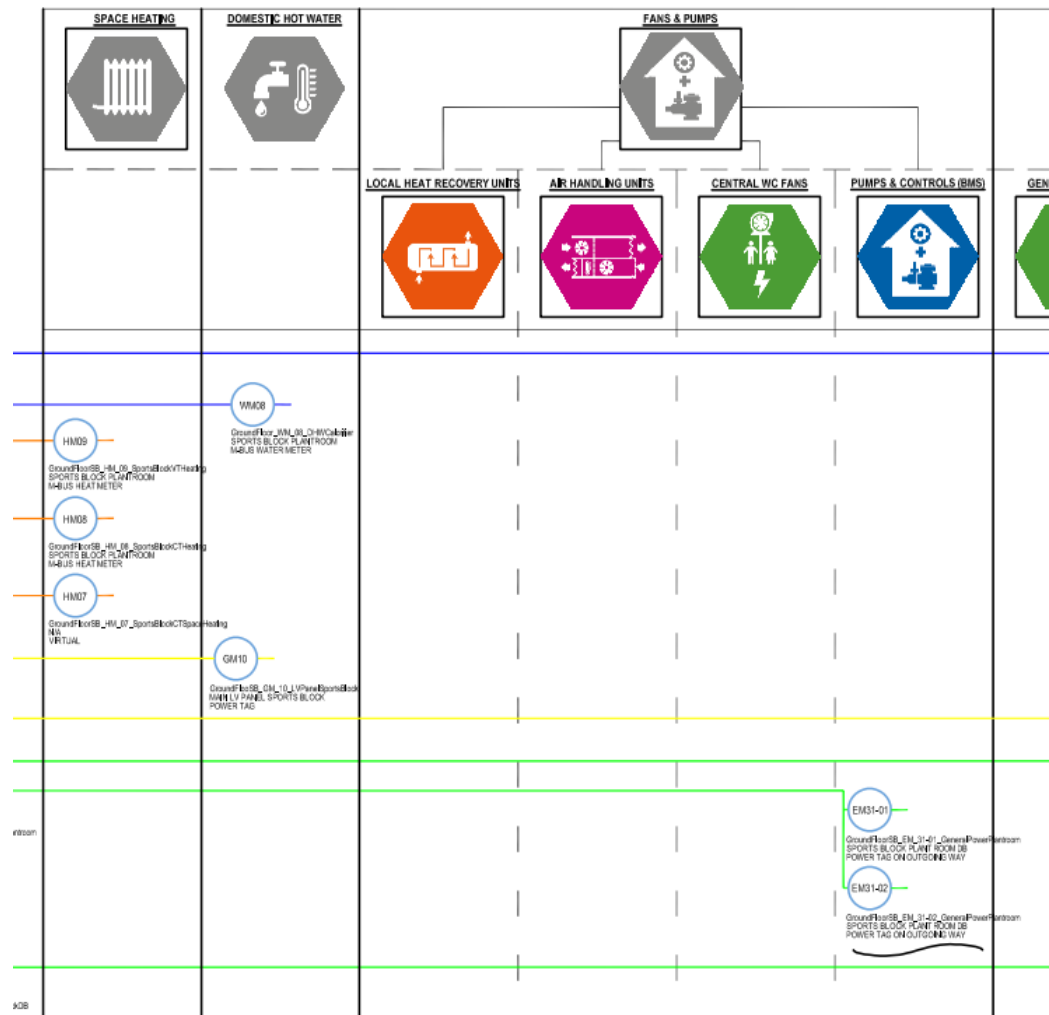


The Validate standard also set out the requirements of B+K and their supply chain to ensure important steps in the process are not overlooked. The table below is taken from the validate document and set out the documentation to be produced and by whom where ‘DCO’ is the MEP Design Consultant, ‘MEC/ELC’ are the Mechanical / Electrical Contractor, ‘BMS’ is the BMS specialist, ‘MCO’ is the Main Contractor, ‘IES’ is IES-VE who will monitor the data produced and ‘ICOM’ is an Independent Commissioning Engineer.

RIBA Stage	Metering Schematic	Metering Spreadsheet	Commissioning Report	Soak Test Report	BPE Report	Measurement & Verification Report	Third Party Validation
Stage 1 – PITT	-	-	-	-	-	-	-
Stage 2 - ITT	-	-	-	-	-	-	-
Stage 3a – Draft CP's	DCO	-	-	-	-	-	MEC / ELC
Stage 3b - Contractors Proposals	MEC	MEC	-	-	-	-	DCO/ ICOM
Stage 4 – Detailed Design	MEC	MEC	-	-	-	-	DCO/ ICOM
Stage 5 – Construction	MEC	MEC	-	-	-	-	-
Stage 6 – Commissioning	MEC	MEC	MEC / ELC	BMS	MCO	MEC / ELC	ICOM / DCO
Stage 7 – Post Handover	MEC	MEC	-	-	MCO	IES	ICOM

By setting this information out, we are able to ensure that all Configure School projects adhere to the same naming conventions and the like to allow meaningful comparisons of data between schools. Templates for all the necessary documents are provided to the supply chain to ensure continuity from project to project.

A major benefit of the Validate process has been to reverse engineer the metering strategy around the DfE End-Use Energy Targets. A snippet of an example Metering strategy is shown below where each meter is placed within the Energy End-Use category, this removes any ambiguity such as if Kitchen Lighting energy consumption comes under ‘Kitchen’ or Artificial Lighting.



The mechanical services that shall be metered under the Validate process is listed below: -

System	Sub-System	End-Use Category	Units	Type
LTHW	CT (Secondary) System	N/A	kWhTh	M-BUS Heat Meter
	Space Heating	Space Heating	kWhTh	Virtual
	Heat Pump(s) Output (Primary Circuit)	Heat Pump Heat Generation	kWhTh	M-BUS Heat Meter
	Catering Kitchen Supply AHU	Catering Kitchen – Canopy Ventilation	kWhTh	M-BUS Heat Meter
	DHW Heat Pumps	Domestic Hot Water	kWhTh	M-BUS Modbus or Heat Meter
Water	Utility Meter at Boundary	N/A	m3	M-BUS Water Meter
	Building Incoming (by building)	N/A	m3	M-BUS Water Meter

	Building Potable Water (by building)	Water – Potable Water Consumption	m3	Virtual
	DHW Heat Pumps	Catering Kitchen – Domestic Hot Water	m3	M-BUS Water Meter
	CAT5 System	Water – CAT5 & Bin Store	m3	M-BUS Water Meter
	Catering Kitchen BCWS	Water – Catering Water Consumption	m3	M-BUS Water Meter
	Excluded Loads*	Water - Excluded Loads	m3	M-BUS Water Meter
	Plantrooms	Water – CAT5 & Bin Store	m3	M-BUS Water Meter
Gas	Utility Meter at Boundary	N/A	kWh	Diaphragm Meter with M-BUS
	Teaching Spaces (Virtual)	Gas – Science / Food Tech	kWh	Virtual

The list of electrical meters to be included under Validate process is shown in the table below: -

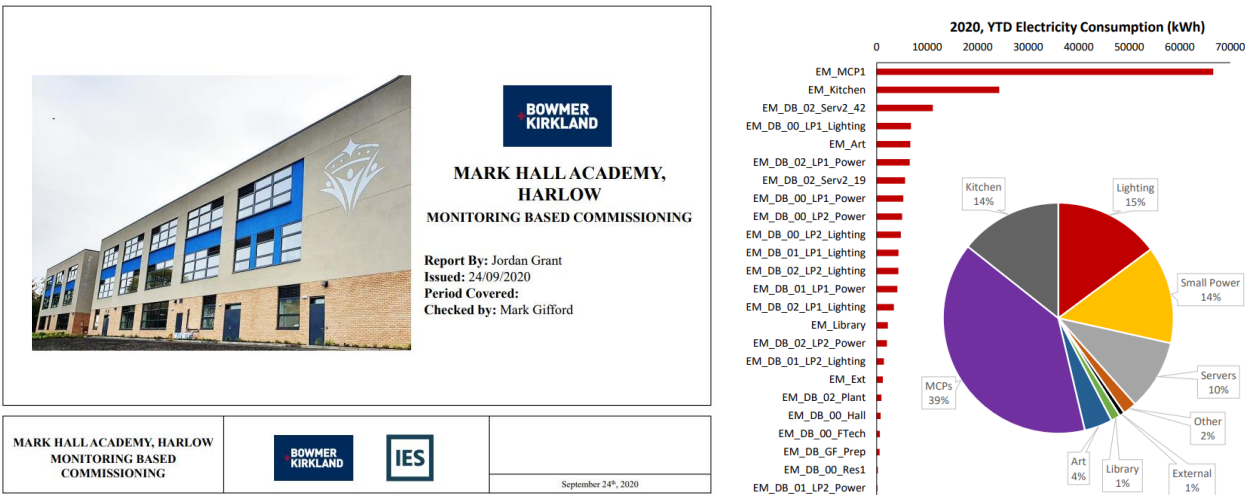
System	Sub-System	End-Use Category	Units	Type
Electrical	Utility Meter at Boundary	N/A	kWh	SMETS2
	Building Incomer (by building)	N/A	kWh	PM5000 64BIT
	Heat Pump Input	Air Source Heat Pump – Heat Pumps (Electrical Input)	kWh	Modbus Powertag or
	Electric Emitters	Space Heating	kWh	Modbus Powertag or
	Point of Use Water Heaters (per floor)	Domestic Hot Water	kWh	Modbus Powertag or
	Electric Showers	Domestic Hot Water	kWh	Modbus Powertag or
	Hot Water Immersion Heater(s)	Domestic Hot Water	kWh	Modbus Powertag or
	Mechanical Ventilation	Fans & Pumps – Central WC Fans	kWh	Modbus Powertag or
	General Lighting (by circuit) (in line with latest Part L requirement)	Internal Lighting – General Lighting	kWh	Modbus Powertag or
	Stage Lighting (if required)	Internal Lighting – Stage Lighting	kWh	Modbus Powertag or
	External Lighting	External Lighting	kWh	Modbus Powertag or
	General Power (by floor)	Teaching Small Power – General Teaching & Learning	kWh	Modbus Powertag or
	Resistant Materials General Power	Teaching Small Power – Resistant Materials	kWh	Modbus Powertag or

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	Food Technology General Power	Teaching Small Power – Food Technology	kWh	Modbus Powertag	or
	Science Laboratories General Power	Teaching Small Power – Science Labs & Prep	kWh	Modbus Powertag	or
	Excluded General Power	Teaching Small Power – Excluded	kWh	Modbus Powertag	or
	ICT Classrooms General Power	ICT Rich Classroom	kWh	Modbus Powertag	or
	Server / Hub Room Active Equipment	Server Room – IT Equipment	kWh	Modbus Powertag	or
	Catering Kitchen General Power	Catering Kitchen – General Power & Equipment	kWh	Modbus Powertag	or
	Catering Kitchen Hot Water Generation	Catering Kitchen – Domestic Hot Water	kWh	Modbus Powertag	or
	Main Building Lift	Lift	PM5000 64BIT	MODBUS Meter	
	Electric Vehicle Charging	Electric Vehicle Charging	kWh	Gateway Receiver	
	PV Generation	PV Generation	kWh	Modbus Powertag	or
BMS	Main AHU Supplies	Fans & Pumps – Air Handling Units	kWh	Modbus Powertag	or
	Plantrooms – Pumps & Controls	Fans & Pumps – Pumps & Controls (BMS)	kWh	Modbus Powertag	or
	Server/Hub Room DX Cooling	Server Room - Cooling	kWh	Modbus Powertag	or

In accordance with DfE OS Annex 2I, a 7 day soak test period shall be undertaken on all project and has been built into the Validate process. The soak test report shall monitor the performance of the installed system and shall include details of any ‘alarms’ raised by the BMS system during the soak test period to ensure that systems operating as intended. An example image of a Soak Test Report is shown below.

New part L Volume 2 has had an updated dated 2021 and takes effect from the 15th of June 2022 – refer to latest building regulation. There are various updates within the regulation including the requirement for general lighting and display lighting should be metered separately, Part L suggest a few methods and the document should be referred too. The above is not an exhaustive list.



In addition to the metering consumption data, further monitoring data will be provided to help assist the school estates team in operating the HVAC systems effectively as possible, the items shown in bold text are over and above the requirement of the DfE OS: -

- Space temperature of each heating zone
- CO₂ levels of each (heating) zone
- Outside air temperature
- Filter status indication as identified within the OS/TA2F and the new BB101.
- Space temperature of areas as identified within Technical Annex 2F.
- CO₂ levels of areas as identified within Technical Annex 2F.
- Supply air temperature of each classroom**
- Exhaust air temperature of each classroom**

Consumption data will be gathered using 15-minute step intervals to provide the school with monthly monitoring and targeting reports using the DfE/K2n (or IES Scan) spreadsheet template. In addition to monthly reports, the school will also be able to review their live performance data through IES Scan platform – please see the below section for further information.

5.0 Mechanical Services Description

5.1 Introduction

The following descriptions detail the mechanical services requirements for University Academy Long Sutton. All systems detailed herewith are accompanied by indicative design drawings which shall be read in conjunction with this outline specification.

The mechanical services solution must reliably provide a suitable environment while minimising energy consumption as detailed in the DfE's Output Specification. Operationally, the building services systems need to be straight forward and easily maintainable. Plant needs to be accessible with minimum disruption to the core business of the building.

All systems and components shall be selected, manufactured and installed in accordance with the latest version of all applicable Building Bulletins, BS/BSEN and CIBSE/B&ES standards and as detailed in this specification.

5.2 Distribution

Distribution of mechanical services shall be predominantly via the ceiling voids and vertical risers as indicated on the Architectural plans. Pipework shall originate from the plantroom and ductwork from the ventilation plant room. Vertical pipework distribution shall be within dedicated risers as indicated on the distribution drawings.

Ductwork distribution shall be concealed within dedicated ceilings voids/bulkheads as indicated on the aforementioned layout drawings. Vertical pipework distribution shall be within dedicated risers as indicated on the distribution drawings.

No 'wet' services shall distribute through the server room space.

Any external pipework shall be fully weather cladded and complete with self-regulating trace heating where required for frost protection.

5.3 Low Temperature Hot Water Heating

A new low temperature hot water heating (LTHW) installation shall be provided comprising an Air Source Heat Pump (ASHP) as indicated on the mechanical schematic drawing. In accordance with the Technical Annex 2F November 2021, the heating system shall be designed to a maximum mean LTHW flow temperature of 43°C.

The heating plant has been provisionally sized as follows:

- Air Source Heat Pump – Approximately 178kW

The heating plant shall be sized to have a minimum of two heat pumps sized at 66-100% of the peak dynamic building load (to ensure 97% of annual energy demand is from ASHP) to provide standby coverage in the event of a minor failure. The quantity and rating of ASHPs shall be reviewed as the

design progresses where electric backup shall be provided for resilience. The heating plant shall be located within the offsite manufactured plantroom located externally from the building.

Pump sets shall be variable speed type and complete with integral speed controllers and pressure transducers located at suitable locations within the index leg. Pump-sets shall be twin-head type to ensure operation in the event of a minor failure to the system. In addition to the pressure independent control valves, self-regulating differential pressure control valves shall be provided (as required) on sub-circuits to avoid disparities in hydraulic pressure from the variable speed circuits. A packaged pressurisation unit shall be provided along with a combined dirt/air separator and other ancillary equipment necessary to make the system operate correctly. A water treatment regime shall be provided within the O&M manuals including a means of dosing the system.

The heating system shall be designed to be capable of maintaining the minimum internal design temperatures listed elsewhere in this specification and the area data sheets.

The OS states that AHU coils, fan coils and radiant panels should be on a constant temperature circuit, and radiators, under floor heating and convectors should be on a variable temperature circuit. The design proposals are that just a constant temperature heating circuit will be installed to serve all emitters. This is due to the fact that the majority of spaces will be heated via heating coils within the ventilation systems. Should there be any radiators or pipecoils within the building it is proposed that these should also be served from the CT circuit. The reason that radiators are traditionally served by a variable temperature system is due to their slow reaction times due to the high water content and for this reason they can be susceptible to overheat a space when it no longer needs heat. It is therefore proposed that radiators installed are low water content type e.g. finned element with casing which provide a fast response time.

All heating pipework shall be insulated throughout in accordance with building regulations. Exposed pipework will not be insulated unless within a space containing vulnerable students.

Please refer to the Heating Philosophy Drawings for confirmation of the heat emitter type proposed for each space where a brief description is given below.

5.3.1 General Staff Spaces

Where individual rooms are ventilated by a dedicated system, the heat recovery unit will incorporate an LTHW heater battery to provide heating to the space. The amount of heat delivered will be controlled by a PICV and local room thermostat so occupants can adjust the temperature by +/- 2°C.

Where individual rooms are ventilated from a central system, an individual duct mounted LTHW heater battery will be installed to provide heating to the space. Within staff spaces, the amount of heat delivered will be controlled by a PICV and local room thermostat so occupants can adjust the temperature by +/- 2°C.

5.3.2 Large WCs

Within Large WC's, the heater battery within the ventilation unit will be controlled by a PICV and local temperature stat(s) linked to the BMS. The space temperature shall be set centrally (via BMS) to maintain the minimum operative temperature with no local control.

5.3.3 General Spaces including Typical Classrooms

Where local heat recovery units are provided, for example classroom spaces (please refer to heating philosophy drawings), the heating shall be delivered via a warm air system. The local heat recovery unit provides fresh air via the heat exchanger but has the ability to recirculate room air incorporating fresh air or 100% recirculation to suit the specific room demand. In both fresh air, recirculation or a blend mode, the local heat recovery unit will have the ability to heat the delivered air via a LTHW heating coil.

The amount of heat delivered will be controlled by the local temperature stat within the wall mounted controller to maintain the temperature criteria identified within the DfE Output Specification Technical Annex 2F. The local wall mounted controller and temperature stat will provide local thermostatic control on a room by room basis utilising a PIC valve in the heating pipework serving the heater battery within the ventilation unit.

The room temperature shall be set centrally (via BMS), the PIC valve shall provide local temperature control where the occupant can adjust the temperature by $\pm 2^{\circ}\text{C}$ via the wall mounted controller.

5.3.4 Staircases, Entrance Lobbies & Circulation Space

Ceiling-mounted LTHW fan convectors (or radiators subject to load) will be installed within these areas where required. Within staircases, the fan convector will be installed at ground floor level and be sized to provide heating for the whole stair core. The fan convectors within staircases and entrance lobbies will be controlled by an integral sensor within the inlet and set to maintain the minimum operative temperature.

Within circulation spaces the fan convector(s) will be controlled by PICVs and local temperature stat(s) linked to the BMS. The space temperature shall be set centrally (via BMS) to maintain the minimum operative temperature with no local control.

5.3.5 Storerooms

Within Storerooms, if required following the detailed design heat loss calculations, heating will be provided in the form of a high level pipecoil. This ensures wall space for shelving etc. isn't taken up by wall mounted radiators. Pipecoils will be control by local TRV's.

5.3.6 Main Hall, Drama Studio, Dining Hall & Activity Studio

These areas shall be heated via the ventilation system in lieu of radiant panels (due to the low maximum mean LTHW flow temperature of 43°C). An LTHW heater battery shall be provided within the ventilation plant. Within double-height spaces, the supply air temperature shall be no greater than 30°C to ensure that the heat is distributed down into to the occupied zone using ceiling mounted swirl type supply grilles.

The heater battery within the ventilation systems shall be controlled by PICV valve in the heating pipework linked to a local temperature stat(s) which is in turn linked to the BMS. The space temperatures shall be set centrally (via BMS) for the Main Hall and Dining spaces to maintain the minimum operative temperatures with no local control. The Activity Studio and Drama Studio will be controlled by a PICV and local room thermostat so occupants can adjust the temperature by $\pm 2^{\circ}\text{C}$.

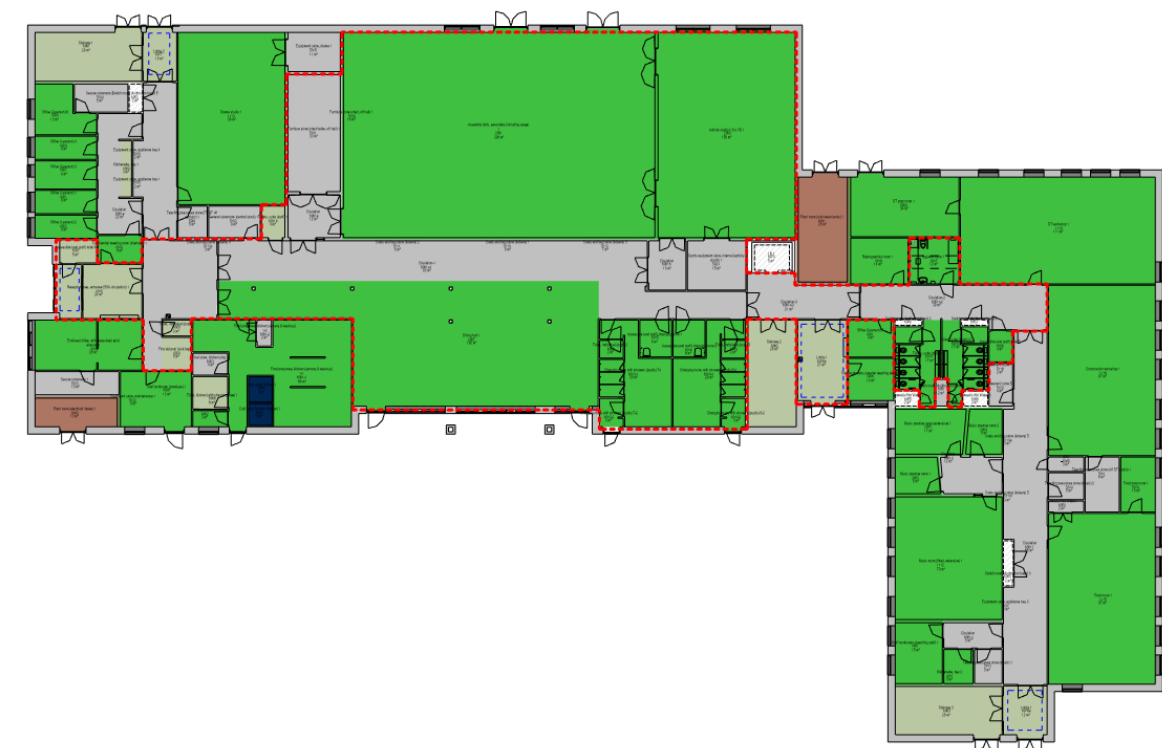
5.3.7 Plantroom and Switchgear Room Frost Protection

Unless demonstrated by the Contractor that it is not required at detailed design stage, background heating shall be provided to the plantroom to provide frost protection where it represents a risk.

If required, the electrical switchgear shall be provided with background heating using an electrical heater to ensure the conditions stay within the manufacturer's required temperature range.

5.3.8 Community Use Zoning

The heating and ventilation system shall be designed to allow for zoning to ensure the spaces are flexible in use and can be used out-of-hours without heating the whole school. The specific zones as indicated within the images below have been agreed with the School during the CEM stage. In addition to this, the heating on each floor is individually zone



5.4 Ventilation

The ventilation system shall be designed, supplied, installed and commissioned as detailed on the ventilation philosophy drawings and as detailed within this specification.

The majority of spaces shall be served by a mixed-mode ventilation strategy with local heat recovery units capable of providing 8 l/s/p. The ventilation systems shall incorporate heat recovery ventilation which is essential to reduce the energy demand of the building and to provide a means of maintaining

the indoor air quality without causing discomfort from draughts associated with natural ventilation in cold temperature, thus satisfying the winter draught criteria from the OS.

In summer, further ventilation can be provided via manually opening windows. A secure night purge ventilation strategy will be operated utilising the local heat recovery ventilation units based upon the local air temperature stat located within each classroom. Current overheating analysis indicates that the summer comfort conditions as defined with the OS can be satisfied for all rooms, please refer to DEIR 080 Environmental Strategy Report for further details.

Please refer to section DEIR 079 Energy Strategy Report which describes the data collected and fault reporting associated with the ventilation systems.

Duct mounted attenuators shall be provided as determined by the Project Acoustician to meet the project brief requirements for each specific space.

As required to provide fire separation in accordance with the project fire strategy, fire and fire/smoke dampers shall be provided with appropriate access for inspection and resetting.

5.4.1 Typical Classroom Local Ventilation

Each classroom will contain a local heat recovery ventilation unit located at high level behind an Architectural raft as indicated on the Architectural Layout drawings. The heat recovery unit shall be fully modulating to provide a mixed-mode ventilation solution where the heat recovery unit is capable of providing 8 l/s/p of fresh air and 400-450l/s of recirculated air (for heating mode). The fans in the units shall be variable speed and shall vary the ventilation volume to the space dependent on readings from a CO₂ sensor and a temperature sensor in each space (to maintain the CO₂ and temperature levels in the Output Specification). A wall mounted controller shall be provided to allow the user to override the heat recovery unit (or boost the ventilation rate) for a set period.

The local heat recovery ventilation systems shall have a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at its peak air flow (of 8l/s/p in a classroom).

Heat recovery ventilation units shall be manufactured from sheet metal and shall include a high efficiency heat exchanger block, supply, and extract filters (if required to suit site conditions), automatic summer bypass and demand controlled modulating air volume.

Each heat recovery unit and bulkhead shall be acoustically treated to achieve noise breakout in accordance with DfE acoustic criteria for classroom area below depending on the area and school type. Acoustic performance must accord with the requirements of the Project Acoustician's report. Acoustic treatment of the heat recovery unit bulkhead shall be provided by the Main Contractor, the Mechanical Sub-Contractor shall ensure the combined acoustic treatment meets the requirements of the Project Acoustician for noise break-out from building services.

Each unit shall comprise low energy, high efficiency fan / motor assemblies with sealed for life bearings. The plate heat exchanger block shall comprise a minimal thermal efficiency of 80%. Filtration shall be provided in line with manufacturer's requirements and the site-specific environmental conditions. Each unit shall be constructed with removable panels allowing full maintenance access to all components.

Each local heat recovery unit shall be linked back to the nearest mechanical control panel by the BMS specialist. The BMS shall provide a time clock control and will enable the units to perform a night-purge mode to pre-cool the exposed thermal mass within each occupied space.

Supply air intake and extract air exhaust ductwork (on atmosphere side of the heat exchanger) shall be insulated in accordance with the latest Building Regulations. Supply air intake and exhaust air grilles shall be incorporated into the window modules as indicated on the Architectural Elevations where indicative positions have been agreed. The supply air grille shall be designed to ensure that the air velocity within the space is no greater than as specified within the Output Specification.

5.4.2 ICT Teaching Rooms

The ICT Teaching spaces shall be served with the same mixed-mode ventilation strategy as the classrooms. This shall be via local heat recovery ventilation units in the ceiling void and shall be to the same standard specification as those used in the classrooms.

5.4.3 Main Hall & Sports Hall Ventilation

The Main Hall will utilise a mixed-mode ventilation strategy incorporating opening windows at high level. This ensures that a passive cross-flow ventilation strategy can maintain comfort conditions for the majority of the year. The mechanical ventilation unit will be in the ceiling void of the adjacent drama studio and shall duct into the main hall above the ceiling. The ventilation shall be sized to satisfy the CO₂ level requirements as required by the output specification, unless the TM52 analysis requires additional ventilation.

When operating in mechanical mode, the ventilation shall be on-demand to suit CO₂ and temperature to provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system. The supply air temperature shall be no greater than 30°C to ensure that the heat is distributed down into the occupied zone using ceiling mounted swirl type supply grilles.

The mechanical ventilation system shall utilise a limited specific fan power of 1.6 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.4 Dining Room Ventilation

The Dining Hall will utilise a mixed-mode ventilation strategy using local heat recovery units located within the suspended ceiling. The ventilation shall be sized to satisfy the CO₂ level requirements unless the TM52 analysis requires additional ventilation. The supply volume shall be 85% of the extract volume to maintain a negative pressure within this space.

A crossflow ventilation strategy has been adopted within this space as per the OS requirements, however consideration will be given to the dispersion of food smells within the building and if necessary, it maybe that cross ventilation is not adapted in the final design subject to Client input.

The ventilation shall be on-demand to suit CO₂ and temperature to provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system. Where available and acceptable to achieve acoustics compliance, opening windows shall supplement the ventilation system.

The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.5 Drama Studio Ventilation

The Drama Studio is to be designed as a 'black box', with no daylight requirements, therefore this room shall be mechanically ventilated utilising a ceiling mounted heat recovery unit that has inlet/exhaust louvre at high level in the façade (see Architects elevation). The ventilation shall be sized to satisfy the CO₂ level requirements unless the TM52 analysis requires additional ventilation.

The ventilation shall be constant volume and provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system. The supply air temperature shall be no greater than 30°C to ensure that the heat is distributed down into the occupied zone using ceiling mounted swirl type supply grilles.

The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.6 Activity Studio & Fitness Room Ventilation

The Activity Studio will utilise a mixed-mode cross-flow ventilation strategy incorporating inlet louvres or opening windows at low level and high level on dual aspects. This ensures that a passive cross-flow ventilation strategy can maintain comfort conditions for the majority of the year. The mechanical air handling unit will be located within the ceiling void. The ventilation shall be sized to satisfy the CO₂ level requirements unless the TM52 analysis requires additional ventilation.

When operating in mechanical mode, the ventilation shall be on-demand to suit CO₂ and temperature to provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system. The supply air temperature shall be no greater than 30°C to ensure that the heat is distributed down into the occupied zone using ceiling mounted swirl type supply grilles.

The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.7 Administration Support Offices and Associated Spaces

Landlocked rooms shall be provided with mechanical ventilation fed from common heat recovery systems. The ventilation system where designed for staff (Adults) shall be sized to provide 10 l/s/p unless the TM52 analysis requires additional ventilation.

The generally mechanical ventilation system shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

Any non-teaching staff only spaces with opening windows could utilise natural ventilation if it can be proven that CO₂, overheating, cold draught, air quality and acoustic compliance can be achieved.

Within any rooms containing printers, 20 l/s per machine (when operated for more than 30 minutes per hour) shall be provided in addition to the normal ventilation rate.

5.4.8 Toilets & Changing Rooms

Extract ventilation is proposed with passive air make-up as required to comply with current Building Regulations where there are 2 or fewer WCs. Where 3 or more WCs are provided, or within large changing areas, supply and extract ventilation incorporating heat recovery shall be provided, where the supply air shall be provided at 85% of the extract rate.

The extract system shall operate to provide a rate of extract ventilation of 6l/s per WC or urinal, as per Technical Annex 2F Table 6-1, and 15l/s per shower as per Building Regulations Part F.

The extract systems serving 2 or fewer WCs shall have a limited specific fan power of 0.5 W/l/s and the supply and extract systems with heat recovery shall have a maximum SFP of 1.6 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.9 DT Workshops, DT Studios and Art Room

These rooms will utilise a mixed-mode ventilation strategy consisting of openable windows.

The rooms will also contain a local heat recovery ventilation unit located within a central bulkhead as indicated on the Architectural Layout drawings. The heat recovery unit shall be fully modulating to provide a mixed-mode ventilation solution where the heat recovery unit is capable of providing 8 l/s/p. The fans in the units shall be variable speed and shall vary the ventilation volume to the space dependent on readings from a CO₂ sensor and a temperature sensor in each space (to maintain the CO₂ and temperature levels in the Output Specification). A wall mounted controller shall be provided to allow the user to override the heat recovery unit (or boost the ventilation rate) for a set period.

The local heat recovery ventilation systems shall have a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at its peak air flow (of 8l/s/p in a classroom).

The heating to the space will be through the incorporation of a heating coil fed from the LTHW heating system. Where available and acceptable to achieve acoustics compliance, opening windows shall supplement the ventilation system.

Local Exhaust Ventilation (LEV) Systems will be installed if necessary, in accordance with Technical Annex 2F, based upon the equipment installed.

5.4.10 Food Room & Food Store

In addition to the local heat recovery ventilation described earlier for a typical classroom, specialist dedicated extract shall be provided to each cooker complete with local extract point sized at a minimum of 42 l/s per appliance. The dedicated extract shall be located within a bulkhead and designed accordingly to suit the acoustic requirements of the room. The dedicated extract ventilation shall be controlled via a wall mounted controller adjacent to the teacher's desk position such that it can be easily controlled to meet the curriculum needs. Make-up air to be provided by openable windows which will be provided with fly guards.

To avoid the smell of food being a nuisance, a cross-flow ventilation strategy has not been adopted within the Food Room.

The ventilation shall provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system. Where available and acceptable to achieve acoustics compliance, opening windows shall supplement the ventilation system.

The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

The Food Storeroom extract ventilation shall be provided based on a minimum ventilation rate of 2 ach. The extract systems serving shall have a limited specific fan power of 0.5 W/l/s.

5.4.11 Science Laboratory, Science Prep Room & Chemical Store

The Science Labs and Science Prep Room shall be provided with mechanical supply and extract and be capable of controlling internal temperature and draughts. The ventilation rate will be based on the minimum requirements stated within Technical Annex 2F Table 7-3.

The ventilation shall be constant volume and provide the heating to the space through the incorporation of a heating coil fed from the LTHW heating system.

Where available and acceptable to achieve acoustics compliance, opening windows shall supplement the ventilation system.

The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

Where a fume cupboard is provided, the ventilation rate during experiments shall be increased and controlled accordingly based on the type of fume cupboard installed.

The Chemical Store will contain a flammables cupboard and chemicals cupboard and therefore supply and extract shall be installed. This shall be a dedicated constant volume unit and be set to operate 24/7. The extract ventilation shall be at both high and low level, with makeup air supplied at high level. The ventilation will be sized to provide 2 air changes per hour. The mechanical ventilation systems shall utilise a limited specific fan power of 1.2 W/l/s and a heat recovery efficiency of 80% when operating at peak air flow.

5.4.12 ICT Server Room

The ICT Server Room shall be provided with locally controlled extract ventilation and filtered supply air (to prevent dust ingress) to remove any gases that may pose a risk of explosion from the UPS batteries and for background ventilation for any maintenance in accordance with the Output Specification.

5.4.13 Sick Bay/Hygiene/Medical Room

The Hygiene room shall contain ventilation incorporating heat recovery (as per the WCs strategy) at a duty of 6l/s per WC or urinal, as per Technical Annex 2F Table 6-1, and 15l/s per shower as per Building Regulations Part F.

The sick bay shall be served by extract ventilation and have a minimum ventilation rate of 2.3 l/s/m².

5.4.14 Kitchen Ventilation

The kitchen ventilation systems shall generally be designed in accordance with BESA DW172 Specification for Kitchen Ventilation Systems. The system shall be designed with access doors for cleaning and inspection as necessary. Ductwork shall be designed and installed in accordance with the Project Fire Strategy.

Efforts have been made to reduce the energy consumption of the catering kitchen including the ventilation system. Having worked with the Catering specialist Airedale Catering, the menu can be delivered with the necessary filters to provide heat recovery on the main ventilation system that serves the main cooking canopy. The local heat recovery unit will be installed in the kitchen ceiling void but the exhaust air shall exhaust at roof level noting a dedicated riser has been provided for this.

To further enhance the energy efficiency of the kitchen ventilation system, the catering canopy has been redesigned to reduce the amount of ventilation. For example, rather than using an open island canopy (i.e. open on all four sides), the canopy is against a wall with side cheeks to reduce the ventilation needed and in doing so reduce energy consumption.

The Servery Area shall be provided with a ventilation rate of 12 Air Changes per Hour fed from the main kitchen supply ventilation system.

The main pot-wash sink shall be ventilated using a condensing ventilation hood (i.e. not ductwork to atmosphere) provided by the Catering Specialists. An air change rate of 30 Air Changes per Hour shall be provided within the pot wash Area.

A local void mounted AHU shall be installed adjacent to the kitchen to provide supply and extract ventilation at air change rate of 6 Air Changes per Hour within the Staff Office (where provided) and 10 Air Changes per Hour within the Dry Store. This system shall operate continuously and provide positive pressure in compliance with DW172.

A separate and dedicated local extract system with duplicate fans shall be installed to serve the WC and Changing Area to provide 10 Air Changes per Hour. Negative pressure shall be maintained at all times.

Any make-up air required to maintain an 85% negative extract air volume regime within the kitchen will be in the form of a transfer duct in between the kitchen and the dining space/servery.

5.5 Cooling

Cooling shall be provided to the server and hub rooms only to meet the requirements of the ICT consultant, as indicated on the heating philosophy drawings. It is hoped that through the development of the ICT solution, cooling in the hub rooms can be avoided. Cooling shall be via a DX split system comprising ceiling/wall mounted indoor unit and external condenser unit. All refrigerant pipework shall be insulated and concealed behind the suspended ceiling. External refrigerant pipework shall be insulated and protected.

Integral condensate pumps (gravity shall suffice where possible) shall be provided within each indoor unit and shall discharge into the nearest stack. Leak detection will be provided to minimise the risk of refrigeration loss. All units shall be provided with wall mounted controls.

A locally controlled ventilation unit shall provide background ventilation in accordance with the OS for the removal of any battery off-gases and for general ventilation for any maintenance staff. Where supply air is provided to a server room, it shall be filtered to prevent dust ingress.

5.6 Domestic Hot & Cold-Water Systems

A new mains cold water supply shall be provided to the building complete with stopcock, mains meter and isolation at point of building entry. Mains cold water shall enter the building in the lower ground floor incoming services room beneath the stairs. The potable (and Cat5) storage is within the roof level tank room (to save booster set related energy consumption), where a booster pump has been provisionally included just in case pressure is not sufficient on the main.

The domestic water services installation shall comply with BS 8558.

5.6.1 Cold Water Storage

Cold water storage shall be provided in the form of a pre-insulated GRP twin compartment potable cold-water storage tank located at the head of the north stairwell (where mechanical plant room is adjacent at ground floor level). Locating the cold-water storage at roof level allows a reduction in energy consumption associated with the cold water potable booster-set when compared with having the storage tank at ground level with the booster set.

The cold water storage will be sized at 5 litres per occupant as per the Technical Annex 2F requirement for secondary schools.

825 pupils and staff x 5 l = 4,125 litres

Potable cold water shall be provided to all the cold-water outlets from the storage tank including drinking water outlets, subsequently the potable cold-water storage temperature shall be monitored by the BMS. We are aware from experience on previous DfE projects that potable water system temperature can rise leading to the need to dump water from the system to bring temperatures back down, therefore we would propose that the water within the system (i.e. within the distribution pipework) is included in the calculation of the water volume requirement.

5.6.2 Category 5 Break Tanks

Water supplies in science accommodation serving sinks and dishwashers used for science equipment shall be designed to cater for fluid category 5 back pressure and back-siphonage. The dedicated cold-water storage tank shall be sized base on the outlets served and be no more than 100 litres per science space. To avoid the tank being located in a room with heat generating plant, a dedicated plantroom for this is located at roof level above the staircase.

Cold water tanks shall be fitted with a sub-meter on the incoming supply and include tank temperature monitoring from the BMS.

Water supplies from the Category 5 break tank serving all science accommodation shall include a device for scheduled water changeover within the system using an end of line programmable (adjustable for time and temperature) automatic flushing and recording device (mains powered and hard wired). This shall be monitored and programmed from the BMS head end.

The Refuse Area / Bin Store shall be provided with wash-down facilities from an adequately protected water supply (category 5).

5.6.3 Water Conditioner

An electro-magnetic water conditioner shall be installed within the cold-water storage tank room on the boosted cold-water supply to prevent scale/calcium build up within the system where calcium carbonate content of the incoming mains water supply is greater than 200mg/l or 14 on the Clark scale.

The conditioner system shall be WRAS approved and be suitable for potable water. If the Contractor can demonstrate that the local water quality does not require a water conditioner, then it may be omitted from the design.

5.6.4 Hot Water Generation

Domestic hot water shall generally be generated by local 'point of use' electrical water heaters. This ensures that hot water is generated independently of the space heating system and avoids the heat loss from circulation systems which can cause overheating.

Hot water shall be provided to all wash hand basins in Toilets and sinks within Kitchens, Art Room, Food Room and Cleaner's Rooms. All other sinks will be provided with cold water only.

The hot water at all wash hand basins shall be provided with a fail-safe thermostatic mixing valve to limit the outlet temperature to 43°C. Taps to Kitchen sinks and Cleaner's Sinks shall receive the water at the full stored water temperature.

The domestic hot water to serve the Main Kitchen shall be generated by a standalone packaged Air Source Heat Pump (ASHP) unit with hot water calorifier. Hot water serving the Kitchen will be generated at 60°C and re-circulated to ensure a minimum return temperature of 55°C. ASHP's shall also be considered for the Food Technology rooms, the main central WC core and the showers within the Sports area as required to meet EUI targets otherwise, Electric (direct) showers will be provided wherever shower outlets are included.

The standing losses for electrically heated hot water services shall not exceed 10W/basin. The length of single pipe domestic hot water pipework shall be limited to prevent legionella. The use of trace heating shall be prohibited.

5.6.5 Thermostatic Mixing Valves

The Contractor shall ensure that the hot water supply temperature is limited appropriately for the device which it's serving. The temperature of the hot water at all basins and sinks in student areas shall be limited to 43°C through the use of thermostatic mixing valves to the TMV3 standard (except where instantaneous water heaters are provided. Where these are provided the flow temperature will be limited). These shall be installed in easily accessible positions for regular maintenance.

5.6.6 Water Efficiency Plan

It is a requirement of the project to provide a water efficiency plan that will be further developed. This will include, but is not limited to, the use of low-flow fittings/low-volume cisterns, leak detection and sub-metering and monitoring.

5.6.7 Water Sub-Metering

Please refer to Section 4 – Energy Metering for further details of the proposed water sub-metering.

5.7 Acoustics

This specification is to be read in conjunction with the Acoustic Engineer's report and briefing documents for the project. The selection of the building services shall be in accordance with the Acoustic requirements of the site and the particular space in which they are situated.

5.8 Sprinklers

The installation of a sprinkler system is not a requirement on this project.

5.9 Building Management System

A central building management system will be installed which will provide monitoring and control of the building services systems. The system will also monitor for faults on items of equipment and will alarm when plant items are operating outside of their set parameters. This BMS system will also provide detailed information on energy metering allowing trends to be identified as part of the overall site energy management philosophy.

A central control panel shall be located within the plant room complete with all necessary switches, lamps and indicators. The control panel shall be a floor mounted galvanised steel cabinet with door interlocked isolators. A front-end PC supervisor shall be provided in the general office where the graphic display will be simple and easy to understand to allow the Facilities Management team to easily identify the different systems and adjust set-points/calendar settings.

Where part of the school is to be utilised outside of normal working hours, the BMS shall provide the facility to override the standard BMS arrangement to allow out of hours operation of the building services within the pre-determined zones. The enabling of out of hours zones shall be via a front-end PC Supervisor.

All control equipment, software, functions, operation, commissioning and demonstrations shall be undertaken via a controls specialist. The controls specialist shall be responsible for all controls related wiring and containment.

The building services shall have local controls within the space they serve to allow end users direct control over their immediate environment. Dedicated temperature sensors shall be provided to all separate controllable zones as required for suitable control of heating, ventilation and night purging systems as well as providing necessary information for building monitoring and energy logging. The BMS system shall be intelligent and intuitive and shall be capable of interaction with different building systems for control, monitoring, fault signals etc.

The controls systems shall be capable of remote monitoring via modem or alternative system. The system shall provide data for the real-time energy consumed within the building via the sub-metering strategy described earlier in this specification. The BMS system shall contain structured security access to ensure that the information and functionality is appropriate to the particular user.

5.9.1 Sub-metering of Substantial Energy Uses

Please refer to Section 4 – Energy Metering for further details of the proposed sub-metering strategy for the project.

5.10 Above Ground Drainage

Above ground drainage will be provided to all items of sanitary ware within the site via UPVC pipework systems in accordance with British Standards, Building Regulations and CIBSE requirements.

Condensate drainage will be provided as required to heat recovery ventilation units and comfort cooling units. Where above ground drainage passes through a teaching space, the drainage shall be acoustically insulated to prevent noise breakout into the space.

The above ground drainage within spaces such as science rooms where chemicals could be poured into the sink shall utilise polypropylene dilution traps as part of the FF&E package.

The above ground drainage installation shall comply with BS EN 12056.

5.11 Insulation

All domestic services, heating pipework, DX cooling pipework and fresh air intake and exhaust ductwork (i.e. atmospheric side of the heat exchanger) or where there is a significant temperature differential between the ambient air and the air within the ductwork, shall be thermally insulated, protected and have suitable vapour barrier where concealed within service routes, risers boxing etc. Insulation levels shall be in full accordance with relevant guidance and standards. Within plant areas all services shall be suitably protected.

5.12 Building Performance Evaluation Methodology

As part of the BPE requirements for the project, it is proposed to have a 7-day soak test period following the commissioning process to ensure the building is operating as intended. Also proposed is seasonal commissioning during the first year of occupation to ensure the systems perform as intended at all times of the year. For further information on the BPE methodology proposed, please refer to DEIR 079 Energy Strategy Report.

6.0 Electrical Services Description

The following descriptions detail the electrical services proposed for University Academy Long Sutton. All systems detailed herewith are accompanied by indicative design drawings which shall be read in conjunction with this report.

The electrical services solutions presented provide a suitable environment while minimising energy consumption. Operationally, the building services systems need to be straight forward and easily maintainable and flexible enough for future changes. Plant needs to be accessible with minimum disruption to the core operation of the building.

6.1 Low Voltage Mains and Sub-Mains Distribution

A primary distribution panel will be established adjacent to the new substation, fed via a transformer mounted air circuit breaker, this will serve the main building.

LV main distribution panels will be established within the ground floor electrical intake room of the building, from this panel the supplies will serve the final distribution boards and bulk supplies as indicated on the single line schematic wiring diagram SRP1155-CHD-ZZ-ZZ-G-E-6100.

Early stage design collaboration within the design team has been undertaken to prevent wet services from running directly above electrical switchgear to achieve compliance with the Output Specification.

From the switch boards, low voltage sub-main power supplies shall be provided to serve loads throughout the buildings.

Please refer to the accompanying proposed mains schematic drawing for further details outlining the philosophy.

The LV switch boards shall comprise of a floor mounted cubicle style arrangement switch board suitably sized for the new development. The switch board arrangement shall be of a modular pattern to allow easy extension and shall include either integral or in room anti-condensation heaters. The switch boards will be fully type tested assemblies with appropriate certification.

The LV switch boards shall incorporate multi-function digital meters to allow for power monitoring of the whole building's electrical energy use. Further energy meters shall be provided on some of the outgoing ways (as detailed on the electrical schematic).

LV sub-main supplies will be installed from suitably rated protective devices within the new LV switch boards to serve the following: -

- MCB distribution boards.
- Mechanical services equipment.
- Supplies to specific loads and larger items of equipment.

Rubber mats running the full length of the LV switch board shall be provided for safe inspection.

Power factor correction will be installed at the main panel.

Transient over voltage protection will be installed at the nearest point to the incomer as part of the new LV switch boards to protect against voltage surges from faults within the supply network, lightning strikes etc.

Final MCB distribution boards shall be mounted at each floor level. Access to the distribution boards will be via lockable doors. These local final distribution boards shall generally be split load boards complete with local energy meters, which provide separate readings for the lighting and power sections.

The electrical demand will be balanced as equally as possible between all phases as part of the ongoing design process and reassessed / checked on completion of the contract.

All low voltage switchgear, distribution boards, shall be sized 10% above the base load for the completed school.

6.2 Future use spare capacity

As per Technical Annex 2G Section 2.3.3.1, the design will allow for 10% physical and electrical spare capacity throughout the LV distribution system including all switchboards and distribution boards in sub-mains and final circuit cable capacities, in protective device capacities, and in all cable containment systems.

All low voltage switchgear, distribution boards, will be sized 10% above the base load for the completed school.

Switchboards and distribution boards are to be provided with a minimum 20% Unequipped spare ways.

All spare ways will be fitted with suitable blanking plates.

The position and arrangement of the main switchboard will be such that there is space allowance for a further cubicle to be added to one side without impact on access requirements within the switch room.

6.3 Resilience

Standby back-up generation for general lighting and power circuits is not proposed for this project. It is not considered necessary within this type of development.

6.4 Sprinkler supply

A sprinkler installation is not proposed on this project.

6.5 Electric Metering

Refer to the energy strategy report (SRP1155-CHD-ZZ-ZZ-G-Z-5100) and metering schematic (SRP1155-CHD-ZZ-ZZ-G-Z-6100) regarding the proposed electrical energy metering.

6.6 Final Circuit MCB Distribution Boards

Each final miniature circuit breaker (MCB) board will be complete with an integral 'on load' isolator and a hinged lockable front cover. The isolator will be lockable in the 'off' position.

With ring main circuits the circuit protective conductor must also be ringed. All socket outlet circuits will be protected with a 32A rated 30mA sensitivity residual current device. Combined MCB/RCD devices shall be installed for this purpose.

All spare outgoing ways which are not occupied by an MCB etc. will be fitted with a proprietary blanking plate.

A circuit chart is to be provided within each distribution board identifying the MCB rating, circuit number and area/equipment served by each final circuit. The chart will be type written and inserted in a clear plastic wallet securely fixed to the back of the hinged distribution board door.

Each distribution board shall be of the miniature circuit breaker type to BS EN 60439, with MCB's to BS EN 60898, minimum breaking capacity 10kA. Barriers and shrouds must be provided to give a minimum index of protection to IP2X with the door open.

The MCB type (i.e. b, c, d etc.) shall be chosen to best suit the load it is protecting.

All distribution boards shall be provided with a minimum of 10% future spare capacity.

All distribution boards shall be lockable.

6.7 Wiring and Containment systems

Wiring and containment systems shall be of types which are entirely suitable for the services with which they are associated in terms of providing for correct functioning of the services and equipment, and of being compatible for the voltage, current and frequency of supply.

All wiring systems shall comply with the requirements of BS 7671 (IET Wiring Regulations). All cabling within the building shall be low smoke and fume type.

All cabling within escape routes shall be supported by metallic containment / fixings which shall not be liable to prematurely collapse in the event of a fire.

Sub-main cables to run from the main LV panel on galvanised ladder or cable tray in corridor ceiling voids on route to risers, where they shall rise vertically, supported on the same, fixed with correctly sized and suitable cable cleats.

All wiring associated with fire alarms and emergency lighting shall conform to the requirements of BS5839 Part 1 2017.

The mechanical strength and rigidity of all wiring systems shall be suitable to withstand the dangers of mechanical damage or electrical forces which might occur during the construction and/or operation of the building.

Plant room areas shall be wired in single core cables installed in steel galvanised conduit and trunking to suit the environment.

The primary electrical services routes will run within the corridor throughout the development and rising vertically in dedicated risers. All services shall be installed in a neat and tidy coordinated fashion.

6.8 Power Factor Correction

The initial design assessment has indicated the building's electrical power factor under normal operating conditions shall be in excess of 0.95 and consequently there is no provision for Power Factor Correction (PFC) on this site.

A Spare way and space shall be provided in the switch board for the school building for future use if it is found PFC equipment would be financially beneficial.

6.9 Earthing & Bonding

The new development shall be provided with an earthing and supplementary bonding system to meet the requirements of the IET Wiring Regulations and BS 7430: 2011

Main bonding will be provided to all main incoming services and plant with supplementary bonding being provided to all metallic services within practical areas, kitchens, toilet areas etc. as required.

A main earth bar will be installed within the main LV switch room. Supplementary earth bars will be provided to main server cabinets for functional earthing.

As a minimum, the following shall be provided: -

- A main earthing conductor shall be taken from the DNO earth point and terminate on an earth bar provided adjacent to the main LV switch board on insulated supports, laFed MAIN EARTHING TERMINAL.
- Main protective bonding conductors to incoming gas, water, building steelwork and incoming telecoms services.
- Supplementary equipotential bonding shall be provided to connect together conductive parts of the electrical and non-electrical items to prevent the occurrence of dangerous voltage between them under earth fault conditions.
- A main bonding conductor will be taken from the main earth bar to the lightning protection system.
- Individual CPC's will be installed in all new sub-circuits, connected individually to the earth bar of the relevant distribution board.

6.10 Supplementary Bonding

The supplementary bonding conductor to low level pipe work, etc., will be taken from an adjacent socket outlet or similar and will be connected to the pipe work, sink top, etc., via a flex outlet plate fixed as close as possible. Cables shall not simply stick out of plaster. Alternatively, where surface conduit is local to the bonding point, the cable may exit the conduit system via a 3-way circular conduit box with one way fitted with a brass-stuffing gland.

Where a supplementary bonding point is within 1 metre of an electrical outlet (i.e. socket or connection unit), the bonding conductor will be taken back to the local circuit earth.

All galvanised trunkings will have copper bonding strips fixed across each joint. All galvanised cable tray/basket and ladder racks where not continuous shall be bonded across breaks.

Circuit protective conductors will be installed from the earth bar of the individual distribution board for each outgoing circuit from that board.

Continuity testing of all earthing systems will be carried out and the tests recorded. Sample tests at random will be applied to duct systems, pipework etc., and across metallised pipe cladding. Measured values must be less than 0.1 Ω .

Wherever possible, bonding shall be carried out to pipe work, etc... above suspended ceilings. Supplementary bonding will be provided within the plant rooms of mechanical plant and equipment.

6.11 Earthing Arrangements for High Protective Conductor Current

In circuits where the current in the protective conductors are lightly to exceed 10mA (generally where a number of PC's are fed from any circuit), then the earthing arrangements for high protective conductor currents shall be provided in accordance with the 18th Edition IET Wiring Regulations Section 543.7.

6.12 General Lighting and Lighting Controls

This section will be read in conjunction with the **DEIR 084 Lighting Strategy Report** which provides further details.

The nature of the project demands a variety of different types of lighting schemes to meet the differing requirements associated with the respective areas. The lighting designs shall take account of the requirements for each of the locations e.g. function, aesthetic qualities, colour temperature, special visual needs, future and routine maintenance.

The lighting installation is to be designed to optimise the internal environment and appearance, whilst minimising energy consumption and maintenance activities. High efficiency, low energy control gear will be provided in the majority of cases to satisfy the schemes low energy requirement.

The requirement for low maintenance is of particular importance since both maintenance staff and spares are often remote from the facility, resulting in delay in replacement or repair.

The lighting controls philosophy in general, owned, occupied spaces (classrooms, offices etc.) to be adopted throughout the new development will incorporate daylight dimming with absence detection. This system of lighting control will providing an energy saving to the client by automatically dimming the artificial light where the natural daylight compensates, requires the end user to force the artificial lighting on as required and eliminates the risk of lighting being left on for long periods of time whilst the room is unoccupied.

Luminaires will utilise energy efficient control gear which will also be dimmable where photocell linked in many areas. Light sources (lamps) will be LED.

All proposed luminaires will comply with the energy usage requirements of the Building Regulations Part L.

6.13 Flexibility & Adaptability

The layout of lighting shall allow for the easy repositioning of internal partition walls to create other spaces within each suite of spaces.

To facilitate the flexibility further, the classroom areas shall be wired using a 'plug & play' arrangement. These systems utilise a Lighting Control Module (LCM) that all fittings and controls are connected to via 'plug & play' wiring. This intelligent LCM can then be programmed to control the connected luminaires as required.

6.14 Classrooms / Teaching Spaces

Refer to DEIR 084 Lighting Strategy Report

6.15 Library / Learning Resource Centre (LRC's)

Refer to DEIR 084 Lighting Strategy Report

6.16 Hall – Stage lighting Bar

Refer to DEIR 084 Lighting Strategy Report

6.17 Office areas

Refer to DEIR 084 Lighting Strategy Report

6.18 Circulation spaces and WC areas

Refer to DEIR 084 Lighting Strategy Report

6.19 Control Gear

Refer to DEIR 084 Lighting Strategy Report

6.20 Lighting Controls

Refer to DEIR 084 Lighting Strategy Report

6.21 Manual Switching

Refer to DEIR 084 Lighting Strategy Report

6.22 Absence Detection

Refer to DEIR 084 Lighting Strategy Report

6.23 Presence Detection

Refer to DEIR 084 Lighting Strategy Report

6.24 Daylight Linking

Refer to DEIR 084 Lighting Strategy Report

6.25 Emergency Lighting

Refer to DEIR 084 Lighting Strategy Report

6.25.1 Escape routes

Refer to DEIR 084 Lighting Strategy Report

6.25.2 Open Plan Areas

Refer to DEIR 084 Lighting Strategy Report

6.25.3 Specific Locations (where applicable)

Refer to DEIR 084 Lighting Strategy Report

6.25.4 Illuminated escape signage.

Illuminated escape signs shall be provided as detailed in the specific building fire strategy and generally in compliance with BS 5499.

The style and details of the safety signs for escape routes shall be common throughout the school and be confirmed acceptable with the local enforcing authority as part of the detailed design.

6.26 External Lighting

Refer to DEIR 084 Lighting Strategy Report.

All external lighting will be provided in accordance with CIBSE Lighting Guide 5, BSEN 13201, BS 5489 and ILP GN01 – The Reduction of Obtrusive Light.

External lighting shall be provided to proposed new walkways, roads and building entrances in accordance with LG5 and building control officer's requirements.

The external lighting colour rendering, installation, efficacies and maintenance issues will all be considered as well as the luminaire positioning relative to each building. The external lighting installation shall have minimum lamp and gear efficacy of 80lm/W for colour rendering $R_a \leq 60$ and 70lm/W for light sources $R_a > 60$.

Where CCTV is provided the external lighting shall be designed to work in conjunction with same ensuring the light does not cause glare to the images.

Lighting columns shall be of the fixed planted type with lockable low-level access doors, allowing access to the cable terminations and local protective device.

External luminaires shall be selected and located so as to avoid light pollution to the surrounding neighbourhood.

All external lighting circuits shall be controlled by an arrangement of photocell, timer switch and manual override. This shall generally be achieved by contactors located adjacent to the local external lighting distribution board. The controls can be changed by the end user, but shall initially be set up to activate when dark, but switched off between the hours of 2300hrs and 0700.

External lighting will utilise LED lamps. The selection of luminaires and lighting philosophy will be agreed with the Client and Design Team during the next stage.

All external fittings selected will be vandal resistant or positioned to limit the opportunity for vandal damage.

6.27 Small Power

Small power will generally consist of wall mounted outlets at an appropriate density for general purpose and fixed equipment use.

Cable runs will need to be carefully coordinated with the building fabric and fixed furniture and equipment layouts in order to minimise the number of conduit drops in/on walls. The use of fixed furniture complete with cable ways shall be considered for ease of installation and provide future flexibility.

All fixed equipment supplies shall be ascertained through Area Data Sheets (ADS's) and Client/end user consultation.

All socket outlets shall be positioned away from sinks to reduce the risk that electrically powered equipment is placed in water.

General power ring main circuits shall be protected by a combined MCB/RCD with 30mA sensitivity installed within the distribution boards.

General cleaners socket outlets shall be provided at 15m centres in all circulation/stairwell spaces and also within each occupied room at low level. Socket outlets shall be single switched socket outlets protected by a combined 30mA/30ms MCB/RCD installed within the local distribution board.

Small power circuits shall be designed to minimise interference to computers caused by electrical faults or failures and to be immune to harmonic currents created by electronically controlled loads.

Accessories will be in compliance with Building Regulations Part M and The Equality Act. Where accessories may be subject to mechanical damage e.g. plant rooms, metal clad accessories shall be used. Weatherproof accessories shall be used for external/wet areas where appropriate.

400V outlets shall be provided in areas as directed by the design process.

Metal clad twin switched socket outlets shall be provided throughout the plant room areas mounted at 1000mm AFFL, they shall be wired on dedicated plant room circuits and protected by a 30mA/30ms MCB/RCD's installed in the local distribution board.

Local supplies from fused connection units will also be included for all items requiring connection e.g. electric water heaters, hand driers, security systems, etc.

The fire alarm, disabled refuge alarm, lift, mechanical control panels shall all be fed direct from the main panel.

Wiring accessories shall be installed at a suitable height and in a location away from wet areas.

Containment, cabling and local power supplies shall be provided for equipment such as ceiling mounted projectors and interactive teaching boards. The equipment shall be procured and installed by the Client.

6.27.1 Hand dryers

Where hand dryers are provided within WC's and hygiene rooms they shall be selected as per the school specific brief and to meet the following Output Specification requirements;

- Have a drying time of less than 30 seconds.
- Infra-red control for no contact start
- Auto-off
- Low noise level of less than 65db at 1m

6.27.2 Electrical supplies for ICT equipment

The server rooms shall be provided with dedicated distribution board fed direct from the respective building's main panels. This dedicated distribution boards shall be located within the rooms and used to feed the server/hub cabinet(s), data rack and a local ring main within the server room.

The above ensures that all associated switchgear is within access-controlled areas and can't be switched off unintentionally.

6.27.3 Audio and Visual Projection Equipment

At the time of writing this report, the audio and visual projection equipment requirements are yet to be confirmed. This shall be confirmed at the next stage of design development.

6.27.4 Portable equipment

Where portable equipment is provided, details of potential fixed furniture layouts together with the electrical loading of each supply point shall be assessed during the detailed design stage of the development to ensure the potential loading of the circuits is fully considered.

Only portable equipment rated at less than 13-amps shall be fitted with a normal BS 1363 plug top, otherwise IP rated BS EN60309 plug and socket arrangements shall be utilised.

All socket outlets that will be used for mains powered portable equipment (indoors or outdoors) shall be protected by a combined MCB/RCD with 30mA or less sensitivity.

6.27.5 Cashless Vending Points

Cashless vending and payment is a requirement for this project,

6.27.6 Schedule of Specialist FF&E (new and transferred)

Suitable power and data outlets shall be provided to suit the proposed schedule of specialist FF&E.

6.28 Lightning Protection

All new buildings will be provided with a lightning protection system in accordance with BS EN 62305-1: 2011; Protection against Lightning" and BS 7671 "IET Wiring Regulations".

This will also include mains and sub-mains surge protection to protect sensitive equipment installed throughout the building.

The proposed lightning protection network will comprise a Faraday cage system.

Final connection to earth would be provided via earth rods, within lockable polymer inspection housings, connected to the PVC sheathed lightning protection tape. Testing of the system would be via the inspection housings.

The lightning protection system is to be discrete as possible, where possible conductors are to be concealed within the building walls.

Cross bonding of metalwork, plant, containment, aerials etc. particularly at roof level shall be provided.

Lift shaft steelwork shall be cross bonded to the lightning protection system at high and low level.

An overall resistance reading to earth of less than 10 ohms shall be provided.

6.29 Surge Protection

Surge protection conforming to the requirements of BS 7671 Section 534 IET Wiring Regulations to protect sensitive equipment installed throughout the building shall be provided.

6.30 Category 6A Structured Cabling and Telecommunications System

It is proposed that a new structured voice and data distribution containment system and installation of Category 6A U/FTP cabling and associated passive equipment shall be provided for the new development.

Active equipment, i.e. which do not form part of the infrastructure such as servers, computers, printers, peripherals, whiteboard, AV solutions, storage, teaching aids etc. shall not form part of the Contract and shall be provided, configured and tested by the Client, unless included within the ICT proposals.

Specification of the UTP cabling will be proposed by the Electrical Sub-Contractor and shall be in accordance with the OS and ICT matrix. For reporting purposes, Category 6A U/FTP cabling is to be installed within the new development.

Where ICT cabling runs through the furniture workstations, careful coordination with the building shall be carried out.

Note: the PABX and handsets including incoming line, active switching and Access Points shall be procured directly by the Principal Contractor and not the Electrical Sub-Contractor.

It should be noted any heat gains from any legacy equipment will not form part of the design unless specifically stated within the school specific brief. The DfE guidance is that the school should be designed for current day ICT heat load The heat loads for classrooms have been allowed as per OS requirements unless stated below;

Incoming Services, equipment hardware and software are to be provided outside the Contract by the Client.

For clarity by this we mean: -

- Local Authority governed broadband (Contractor selected broadband fibre included)
- File Servers
- For the telephone system beyond SLT members.
- Routers
- Computers and peripherals
- Paging systems, Dect Phones (dect functionality to be delivered through mobile phone networks for flexibility) or any other communications solution used by the school.
- Red care monitored phone line rental for intruder alarms and fire alarms.
- Dedicated phone line rental for lifts
- Other items of a similar nature
- Any software

Different authorities and organizations have different ideas, budget, concepts and expectations with regards to service providers for incoming services, equipment hardware and software and usually have an in-house department who manage these. For this reason, we propose to exclude these from the contract proposal and leave the Client to make their own arrangements which can be connected and utilize the proposed structured cabling system.

Refer to the electrical philosophy drawings, which indicate schematically the proposed cabling solution and the layouts.

6.30.1 Wireless Access Point

Wireless capability shall be provided installed at high level in ceiling voids as denoted in the ICT matrix.

Black spots such as around the building's core are obvious areas for additional access points, however, concrete floors cast on metal decking can be an advantage as they shield one floor from the next and prevent "overspill". This means that the wireless signal is contained on just one floor which helps maximize the system's capacity.

6.30.2 Associated Mechanical Cooling

Where required, mechanical cooling will be provided to the server room and is included within the Mechanical Services proposals.

6.31 Fire Alarms

A new fire alarm system will be provided.

The new fire alarm system shall meet the requirements of BS 5839 Part 1: 2017 and relevant Building Regulations stipulations.

For the completed new school building the system category shall be a Category L2, addressable fire alarm system (open protocol) as defined by BS 5839: 2017.

The system shall be an addressable system and designed for low false alarm potential.

The new fire alarm panel will be located in the designated Fire Brigade entrance area of the building. The panel will be fully recessed and have a framed zone diagram adjacent.

All wiring associated with the new fire alarm system shall be carried out using Standard grade PH60 fire resisting pliable red sheathed cables manufactured to BS 7629 and shall be in accordance with EN 50200, clipped direct or installed on dedicated cable tray/basket.

The fire alarm system shall send a signal to an external monitoring station in the event of an alarm. A 'redcare' telecommunications link will be provided for remote monitoring of the fire alarm system.

The detectors shall be chosen to suit the environment and mitigate false alarms.

Automatic detectors shall be provided in all voids of height more than 799mm or where otherwise recommended in BS 5839.

Sounders shall be located in all areas of the building to ensure that under alarm condition, the alarm sound pressure is not less than 65 dB(A) in general areas and 60dB(A) in stairways, spaces under 60m³ and specific points of limited extent.

Visual Alarm Devices (VAD's) shall be provided that comply with EN54-23, to areas where persons of impaired hearing could be in relative isolation & in noisy areas. The general strategy shall be to provide VAD to cover toilet areas, shower blocks & individual person offices, plant rooms etc. This does rely on a management procedure being put in place to alert persons of impaired hearing within multiple occupied areas, this strategy will be reviewed as part of the design development and agreed with the fire consultant.

Fire alarm interfaces shall be provided, as a minimum for the following systems: -

- HVAC control panels
- Automatic opening doors
- Fire door hold open devices.
- Main Gas shut off valve to the building (where applicable) (with adjustable time delay)
- Disabled refuge alarm panel (activating same)
- Security systems (electronic access control)
- Passenger Lift (deactivating under alarm conditions)

The fire alarm system shall be designed such that the system can be easily extended to incorporate additional manual call points, automatic detectors and alarm sounders which may be needed in the event of additional partition walls being erected. The fire alarm protocol shall be such that the system may be extendable site wide.

Magnetic door holders shall be provided on all cross-corridor access doors that are positioned on fire barrier boundaries (unless doors form part of the access control strategy, as indicated on the security drawings). Each pair of magnetic door closers shall be provided with a test/close door facility. On receiving a fire alarm signal, the door hold open device shall de-energise and release the cross-corridor doors to close.

Wherever possible, fire alarm manual call points shall be located such that they are less likely to be prone to malicious operation.

Sounders shall be capable of providing a minimum of three distinct tones; alarm activation, alarm deactivation and for signalling class change.

The complete new fire alarm system shall be zoned to the recommendations set out in BS 5839 and the requirements of the Local Fire Authority. Fire alarm zones shall be arranged so that the indications of the fire alarm system can be rapidly related to the layout of the building.

At this stage, the fire alarm system proposed will be a single stage evacuation system on an alarm condition, unless otherwise agreed with the Client and relevant Local Authorities.

6.32 Class change System

A class change system will be provided for the new school development. The system shall be capable of being programmed for the scheduled requirements of the school, whereby there is a system of tones to denote the start of the daily school session and to identify the end of the various periods. This will be dependent on the specific school timetable and therefore the system shall be flexible enough to deal with changes to timetable.

The class change system programmer will provide day and week programmes and battery-operated memory back-up. It shall provide a signal throughout both blocks. The outputs shall be capable of being programmed with continuous or pulsed time adjustable modes.

The system shall be flexible enough to allow the end user to alter the times to deal with changes to the timetable.

The class change system shall be integrated with the fire alarm system using the same sounder units, however the tones shall be significantly different to the alarm tones generated by the fire and intruder alarm systems and will cater for a number of different sounds to be configured by the school staff as appropriate.

Careful positioning of external sounder(s) shall be given so not to cause a nuisance to neighbouring properties.

6.33 Security Systems

The Security systems shall be zoned to allow areas used by the Community outside the School Day in a similar way to the heating, lighting, ventilation and security systems.

A complete, coordinated and discrete arrangement of security systems will be provided.

As a minimum, the security systems will consist of: -

- CCTV system to the schools' main entrance doors – main building (GDB requirement).
- The school would like to decant the current CCTV (32 no. cameras internally and externally) to the new building- SSB.
- Intruder alarm systems to main building
- Electronic access control door entry system

6.33.1 Zoning

Internally the school shall be zoned to enable access to areas to be varied and controlled flexibly for school hours or out of hours use.

Security services shall be proposed in order that entrance to community facilities during the evenings and weekends can be isolated and restricted. All these entrances shall be fully accessible and secure.

6.33.2 CCTV system

For details refer to SRP1155-CHD-XX-XX-T-E-0008 - Security Strategy Report

6.33.3 Intruder Alarm system

For details refer to SRP1155-CHD-XX-XX-T-E-0008 - Security Strategy Report

6.33.4 Electronic Access Control Door Entry Systems

For details refer to SRP1155-CHD-XX-XX-T-E-0008 - Security Strategy Report

6.33.5 Library Book Detection System

The requirement of a book detection system is to be confirmed by the Client.

6.33.6 Panic Alarm System

A panic alarm system shall be provided to the main reception/general office for the use of the main reception staff. The alarm shall be an extension of the disabled toilet assistance call system in the form of a hidden but accessible push button which is linked to an audible alarm.

6.34 TV System

Digital terrestrial TV reception equipment will not be provided.

6.35 Audio Frequency Induction Loop System (AFILS)

To assist visitors that have impaired hearing, induction loop systems shall be provided in accordance with the code of practice for AFILs: BS7594 2011 as detailed below;

- A permanent fixed induction loop system shall be provided to the main reception desk.
- A permanent fixed induction loop system shall be provided to the main hall.
- A further three number portable handheld induction loop systems shall be provided. The intention is these shall be stored at reception and collected/used as necessary.

6.36 Assisted WC Alarm

Each assisted/disabled WC shall be fitted with a disabled distress alarm with local reassurance lamp and re-set control. In addition to the over door lamp and audible buzzer, the alarms shall be connected to a central control location (generally the reception area) to audibly and visually indicate which WC triggered the alarm.

All assisted/disabled WCs will be provided with an assistance alarm enabling anyone using the facilities to call for assistance if required. The system will consist of a red pull cord with triangular handle, reset call button, above door lamp/tone unit and associated power supplies.

6.37 Disabled Refuge Alarms

A Disabled Refuge Alarm system will be provided, in accordance with BS 5839-9, The Equality Act and Building Regulations for safe efficient emergency evacuation within the new building. The master panel shall be located adjacent to the main F/A panel, with outstations located at each disabled refuge area.

The Disabled Refuge Alarm system shall be interfaced with the fire alarm system so as to operate only when the fire alarm system is in fire evacuation mode. The Disabled Refuge Alarm system shall allow voice communication in either direction between a central point and a number of outstations throughout the building in a fire emergency situation.

The intended uses for the system are as follows: -

- Use by the management of the building for its initial evacuation.
- Use by the fire service during and after evacuation.
- Use by disabled people.

The Disabled Refuge Alarm master station shall be located within the main entrance lobby adjacent to the fire alarm panel with 24-hour battery back-up, intercom, audio/visual alarm and remote intercom units with reassurance lamps at the refuge outstations.

Careful consideration shall be given to F/A sounders in close proximity to any of the panels, ensuring the audio communication can be undertaken during an alarm (Visual alarms may be provided in these areas).

Outstations for use by disabled people shall be located in designated refuges. Outstations shall be mounted at a height appropriate to the application.

All wiring associated with the Disabled Refuge Alarm system shall be carried out using Enhanced fire resisting pliable red sheathed cables manufactured to BS 7629 and should meet the PH120 classification in accordance with EN 50200 clipped direct or installed on dedicated cable tray/basket.

6.38 Electric vehicle charging (EV)

11No 7kw active EV charge points are to be provided; 19No Passive EV charge points are to be provided (Ducts to spaces for future provision).

6.39 Photovoltaics (PV)

Photovoltaics are to be provided in line with School Sustainable Strategy (SS6) Response

6.40 Electromagnetic Compatibility Regulations

Electrical installations shall be compliant with the requirements of the Electromagnetic Compatibility Regulations. The regulations describe the electrical installation as a manufactured item, and therefore require the mechanical and electrical service installation to be tested for electromagnetic radiation and absorption.

Procurement contracts for all electrical equipment associated with the distribution of the electrical installation should stipulate that the equipment must be compliant with the Electromagnetic Compatibility Regulations.

6.41 Spare Keys

Spare keys shall be provided for all electrical and mechanical plant such as distribution boards, mechanical control panels, lighting columns etc.

6.42 Access for Maintenance

Early consideration shall be given for access and routine maintenance of the electrical installation, irrespective of the size, complexity and the extent of the proposed installation.

Electrical services shall not compromise the space and access routes for other services such as mechanical and public health. Maintenance tasks shall be able to be undertaken with the minimum disruption to the continuity of supply and day to day business.

6.43 Operation & Maintenance

End user training shall be provided to all electrical systems installed. Invitations to the training sessions shall be made well in advance, however it will be the end users' responsibility to ensure the appropriate persons attend.

A full set of suitable Operation & Maintenance (O&M) manuals and as-installed drawings shall be provided on completion of the project in both hard and electronic formats.

The above detailed O&M manuals shall hold detailed information in support of the design, construction, installation and management of the electrical services provided. These manuals shall be collated as recommended by the BSRIA guide.

A building logbook shall be provided, this is a very simplified version of the O&M manuals, providing an overview of the services provided, however this logbook is predominantly aimed at energy use and will contain information on predicted energy usages, how to assess the buildings energy use and maintain good energy use practices.

The logbook shall be based on the format and recommendations of CIBSE TM31.

An important part of the O&M information shall be the recommended maintenance procedures, which need to be carried out by the end user. These shall be detailed for all equipment installed and the procedures are required to ensure the equipment installed operates at its optimum performance and retains its full manufacturers warranty.

Building Services Strategy Report

6.44 Testing & Commissioning

The electrical services installation will be inspected and tested to verify that the Regulations of BS 7671 18th Edition IET Wiring Regulations have been met and the installation meets with the design.

A commissioning strategy shall be produced, this will detail the extent of commissioning and the process to ensure that full commissioning aligns to manufacturer's installation and commissioning requirements.

The commissioning strategy will include involvement and representation by the Clients Representative for witnessing commissioning and being informed throughout the process.

7.0 Passenger Lift Installation

Lifts are not required to be provided for general pupil and staff movement but for ensuring access is available to all areas by those with physical difficulties and assisting with distribution of heavy furniture and equipment.

For evacuation of mobility impaired pupils and staff the building shall be designed to enable all occupants to escape unaided so far as is practicable. In multi-storey buildings such as University Long Sutton, evacuation lifts shall be provided rather than standard passenger lifts. In mainstream schools the provision shall be related to the number of pupils and storeys served:

a) for new schools with no more than two storeys and fewer than 900 pupils, a single evacuation lift of 1400mm x 1100mm (internally) minimum.

b) for larger schools with at least three floors and 900 pupils or more, a single two wheelchair lift of 2000mm x 1400mm, or two lifts of 1400mm x 1000mm (internally) adequately separated on plan will be provided.

University Academy Long Sutton is a 3-storey mainstream school with provision for 800 pupils and 1Nr. Evacuation passenger lift is proposed on the architectural plans.

The lift shall be provided in full accordance with all current and relevant British and European standards, including BB100, BSEN81/1 and BSEN81/2.

All evacuation lifts shall be provided with a secondary / alternative emergency supply as per BS 9999.

The secondary supply will be provided inline with the BS and a UPS has been provided locally to the lift.

The passenger lift will be sized to be in line with the requirements of The Equality Act, BS8300 Design of buildings and their approaches to meet the needs of disabled people, EN81-70 and Part M of the Building Regulations and the DfE requirements.

The passenger lift shall be key access controlled, protecting use for disabled pupils, staff and visitors only via operation of the key.

Passenger lift finishes are to be agreed by both the architect and Client prior to any orders being placed, chosen from the manufacturers standard ranges.

The lift will be provided with remote communication system via a 24-hour manned rescue service to notify an appropriate party of their location and initiate their release.

Standard lift will be interfaced with the fire alarm system to return to the ground floor level, doors to open and then be disabled under fire alarm conditions.

Evacuation lifts will be interfaced with the fire alarm system to return to the ground floor level, doors to open. The agreed use for evacuation purposes will need to be agreed with the relevant authorities.

8.0 Building Regulations Part M and The Compliance

Building Regulations Part M has several recommendations for the construction of new or alterations and extensions to non-domestic buildings. The Client should confirm early on in the design process any site/project specific requirements which shall need to be incorporated within the design of the building services to ensure these are included for.

The location and detailing of all wall mounted switches and controls shall take into account ease of operation, height, and distance from corners, visibility and unobstructed access.

Switches, sockets and controls shall be selected to not require the simultaneous use of both hands to operate same.

In areas where a member of the public should be able to operate the controls (such as disabled / ambient WC's), large push pads shall be provided. Large Push Pads are easier to operate and locate. The Disabled Living Foundation states a wide large push pad is one that can be operated by use of a fist or even an elbow. Switches such as those offered by MK electric from their Logic Plus wide paddle ranges (or equivalent) shall be offered.

Outboard rockers - Switches on multiple socket outlets should be separated to avoid inadvertent selection of an adjacent control by visually impaired people and people with limited dexterity. Outlets such as those offered by MK electrical (or equivalent) with outboard rockers shall be offered.

Switch socket outlets shall have an indicator when they are on.

Totally flush or recessed controls shall be avoided, as these are not accessible to people with limited dexterity.

Colour and tonal contrast shall be used to ensure controls are distinguishable from their background. A coloured back drop on outlets mounted on walls and coloured lids to skirting trunking / dado trunking shall be the general solution.

Contrast - "Controls that contrast visually with their surroundings are more convenient for visually impaired people". Part M states that switches outlets and controls will satisfy the regulation if there is a contrast of 30% Light Reflective Value (LRV) between a front plate and wall. White has an LRV of 100, and black 0. As part of the design development this shall be given consideration to ensure controls have contrast with their surroundings.

Switched socket outs, spurs and circuit isolator switches shall indicate clearly whether they are 'on' or 'off'.

Consideration shall also be given to the use of tactile buttons and controls. These should be embossed and not engraved.

Presence detection - Detectors (Passive infrared or microwave) that detect movement and turn lights on and off according to occupancy shall generally be provided, not only reducing the energy consumption, but reducing the need for person to use switches.

Disabled WC facilities shall be provided with alarm systems, consisting local alarm and remote indication. Part M recommends pull cords for emergency alarm systems to be coloured in red and that all pull cords should be fitted with bangles to aid grip.

Installation height - Switches and socket outlets for lighting and other equipment should be located so that they are easily reachable.