R01

Building Services Description of Systems

UCL - Institute of Education – Phase 2 Works

Issue Register

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1.0 Introduction

The University College London (UCL) Institute of Education (IEO) is located at 20 Bedford Way London.

The structure is formed from an existing Grade 2 Listed Building.

The topography of the space comprises of a central block with radiating wings.

The IOE is the subject of capital investment plan to modernize, restack and improve the existing facilities.

This document describes the proposed services modifications forming part of the Phase 1 Works.

These works encompass the refurbishment of the Wing A, the Core B and C, as well as the associated Plant Rooms which serves these.

The new works are planned to both modernize and improve the quality of services provided.

The following building services descriptions of systems should be read in conjunction with the Employers Requirements Particular and Standard Specifications.

2.0 Mechanical & Public Health Services

2.1 Mechanical & Public Health Services

The building benefits from an extensive existing mechanical & public health infrastructure consistent with the generally high standard of this renowned Grade 2 Listed building.

The proposed works involve the extension and modification of the infrastructure to deliver reliable mechanical services of current standard to the areas served.

The building services will designed to meet the building BREEAM Employers Requirements Targets.

The following narrative sets out the respective design criteria and system description.

2.2 Design Criteria

2.2.1 External Design Criteria

Summer	30°C db	
Winter	-4°C db	-4°C wb
Heat rejection plant ambient selection		35°C db

Refrigeration plant shall be capable of operating up to a maximum temperature of 40°C at reduced capacity.

2.2.2 Internal Temperature and Humidity

2.2.2.1 Teaching Spaces/Breakout/Learning

Temperature

Summer	24°Cdb +/- 2°C
Winter	22°Cdb +/- 2°C

Humidity

Summer	50% RH
Winter	50% RH min

2.2.2.2 Non air-conditioned user areas

Temperature

Summer	24° ± 2°C
Winter	22°C ± 2°C

Humidity

Summer / Winter	Not controlled

2.2.2.3 Toilet Areas

Temperature

Summer	Not Controlled
Winter	18°Cdb +/- 2°C

Humidity

Summer / Winter	Not controlled

2.2.2.4 Reception

Temperature

Summer	24°Cdb +/- 2°C
Winter	20°Cdb +/- 2°C

Humidity

Summer / Winter	Not controlled

2.2.2.5 Corridors (to unconditioned areas)

Temperature

Summer	Not Controlled
Winter	18°C minimum

Humidity

Summer / Winter	Not controlled

2.2.3 Occupancy

Refer to room data sheets and associated furniture architectural general arrangement drawings

2.2.4 Fresh Air and Ventilation Rates

Primary fresh air supply ventilation flow rates onto the office floor plate:

Offices	12 l/s per person
Teaching Spaces/ Breaking Out/Learning Tea Point/ Media Booths	10 l/s per person
Toilets	8 ac/h (extract)
Tea point	50 l/s

2.2.5 Infiltration Rates

Above Ground Floor	0.25 ac/hr infiltrations to perimeter office zone. This infiltration utilized for terminal unit heating and cooling selection

Air leakage for the completed building envelope should be controlled by the main contractor so as to not exceed $10m^3/hr/m^2$ at 50 Pascal differential test pressure. The Building to be pressure tested in accordance with Building Regulations Part L requirements.

2.2.5.1 Internal Heat Gains (Infrastructure)

People / Areas	
Occupancy:	90 W/m^2 (sensible) 50 W/m^2 (latent)
Lighting: Teaching Spaces/Seminars Offices/ Corridors Toilets	12 W/m^2 12 W/m^2 8 W/m^2 5 W/m^2
Small Power : Teaching Spaces Seminar Rooms Break Out / Learning Areas Offices open plan Offices Cellular Meeting rooms	 25 W/m^2 25 W/m^2 25 W/m^2 25 W/m^2 25 W/m^2
Server Rooms	10 000 W

2.2.6 Filtration Standard

The following filtration standard will be achieved:

- Specification Euro vent 4/5
- Primary filters EU 3
- Secondary filters EU 6

2.2.7 Noise Criteria – Internal

The following NR ratings will be achieved.

- Teaching Spaces NR 25-35
- Open Plan Offices NR 40

The Building Services will be designed to meet the Employers Requirements Acoustic Consultants Report.

Internal noise levels will further be as defined by IS0 R 1996, shall apply at a distance of 1.5m from any grille/diffuser (at an angle of 45°C) or any wall surface.

2.2.8 Noise Criteria – External

The Building Services will be designed to meet the Employers Requirements specified in the Stage 2+ Acoustic Report

Noise criteria as specified at 1.0m outside the nearest open able window.

The proposed scheme does not include for night time operation of the main building services plant.

2.2.9 System Operating Parameters

The following operating parameters will be provided:

Office supply air 22°C Summer 22°C Winter

2.2.10 Refrigerant

The selected refrigerant will be Zero ozone depletion potential

2.2.11 Fire Rated Ductwork

All ductwork crossing escape routes (not serving the respective areas) will be fire rated throughout from point of entry to point of exit.

2.3 Heating Systems

2.3.1 General Overview of Central Plant

Low temperature hot water (LTHW) will be provided to the IOE from the existing district heating system. This will serve both room space heating and domestic hot water systems.

The ISD area and North Wing areas at Level 2 and 3 will be served from the existing low temperature hot water (LTHW) derived from the existing district heating system. The main district heating distribution plant rooms are located at Level 2 referenced PR5/8 and PR3 respectfully. These plant rooms are provided with plate heat exchangers to separate primary (district heating) from secondary heating circuits (building) networks.

The building LTHW system design will be based on the following:

Flow Temperature: 82ºC
Return temperature: 62 ºC

New LTHW circuit will be installed to serve new wing radiators for Wing A level 3 and the Core B & C Level 3 ISD zone. These circuits shall be fitted with pressure differential control valves on the main runs to serve the existing and new proposed radiators installed as part of the phase 1 works

2.3.2 Wing A - Level 3 Heating System

The North Wing will be fitted with new two pipe radiator pipe work systems. The pipe work will be connected from the level 4 two-pipe network and connected from plant room PR3. This LTHW network will be served from a dedicated LTHW secondary pump located within plant room PR3.

The LTHW radiators will be fitted within bespoke fitted Architectural casings. The main contractor will gain the building services contractors prior sign off to ensure that the radiant effect and system controls are not inhibited by the chosen casing.

The thermal energy from the new LTHW branch serving this area will be sub-metered.

The LTHW radiators will provide the majority of the heating to the perimeter areas directly adjacent to the curtain walling to offset thermal losses.

This will work in combination with Fan Coil Units to areas where they are required to provide thermal comfort.

The control systems will be integrated so as to prevent cooling and heating being applied concurrently.

2.3.3 Wing A - Heating System

A new LTHW radiator system will be installed which will provide heating within this area, except from in small meeting & focus rooms which will be heated by LTHW served wall mounted Fan Coil Units.

2.3.4 Core B&C - Level 3 ISD Area Heating System

The 3rd floor level of ISD area will also be fitted with a new two pipe radiator system served off the existing LTHW circuit.

This new LTHW pipe work circuit will be connected to the existing pump circuit fed from existing pumps P4A/B.

The new 4-pipe fan coil units will be fed from this same LTHW heating circuit. The LTHW radiators will be fitted within bespoke fitted Architectural radiator casings. The main contractor will gain the building services contractors prior sign off to ensure that the radiant effect and system controls are not inhibited by the chosen casing.

The thermal energy from the new branch circuit serving the LTHW radiators and the Fan Coil Unit (FCU's) will be sub-metered.

2.4 Cooling Systems.

2.4.1 Core B & C Level 3 ISD Area Cooling System

Two existing packaged water cooled chillers rated at 474 kW each provide chilled water to the ISD.

The associated condenser water plant is located above core B at level 11 and comprises of 4 Number existing air cooled condenser units.

The primary chilled water temperatures are as follows:

Flow Temperature: 7ºC
Return Temperature: 13ºC

Chilled water (CHW) will be provided from the existing network capped off at high level on level 3 next to core B. The existing pumps within the plant room at Level 11 will be re-commissioned based on the new CHW flow rates derived from the new cooling load of the equipment and provided by 4 pipe Fan Coil Units (FCU) serving the ISD zone at Level 3.

The teaching/office spaces will be conditioned by the use of the above FCU systems:

The thermal energy from the new CHW branch serving this area will be sub-metered.

2.4.2 VRF Cooling Systems to Wing A Level 2 & 3

Variable Refrigerant Flow (VRF) systems will provide cooling to Wing A Level 2 and 3

2.5 Environmental Control System

2.5.1 System Common Features

Condensate will be removed from the fan coil unit drip tray via gravity to local soil stacks within the cores areas. Where this is not practical the condensate will be pumped from mini condensate pumps. Respective FCU will be fitted with volt free contacts to ensure that it is isolated from the system in the event of the condensate pump failure.

The FCU's will be fitted with lined acoustic discharge plenum from where the conditioned air will be ducted via a rigid ducting to lined linear supply plenum. From the plenum the conditioned air will be discharged via a linear 4 slot supply diffuser that will align with the raft ceilings. Where there are no rafts the air will be ducted to high induction swirl diffusers. All the supply ductwork will be insulated. Air will be returned back to the FCU's via the occupied space. Fresh air supply will be delivered to the back of the FCU's via primary supply ductwork served from centralized air handling units.

Every office/study zone will be provided with a wall mounted controller to facilitate user adaption of the room temperature set points,

2.5.2 LTHW Heating

LTHW heating shall be provided by radiators in the perimeter zones which shall fitted with thermostatic radiator vales.

2.6 Ventilation Systems

Fresh air ventilation will be provided to the various areas via dedicated air handling units (AHU's). These air handling units will be fitted with energy reclaim in the form of thermal wheels or run-around coils.

- AHU-PR3-01a – Serves Core A Levels 1-5 (6.47 m³/s)
- AHU-PR3-01b – Serves Core A Levels 1-5 (4.31 m³/s)
- AHU-PR5/8-02 – Serves Core C & B Levels 1-5 (4.50 m³/s)
- AHU-PR2-01 Serves Core A Levels 6-9 (10.56 m³/s)
- AHU-WL8-01 – Serves Wing A Levels 6-9 (3.87 m³/s)

Air handling units will be fitted with suitable filtration to minimize external air pollution and will all be heat recovery units with heat recovery efficiency to satisfy the Employer BREEAM requirements.

All air handling units will contain heating and cooling coils for condition incoming air. The operation of the heating/cooling coils will be interfaced with controller system to facilitate communication data to be converted to BAC net code and enabling the control and monitoring of these units via the BMS.

The fresh air will be ducted from atmosphere to the AHU from where it will be ducted to the occupied space. Similarly return air will be ducted back from the space to the AHU and then ducted to atmosphere. There will be a minimum distance of 10 m between the fresh air supply and the exhaust louvre.

Sound attenuators will be fitted external to all AHU's both system and atmospheric side.

Fresh air will be supplied at 22ºC throughout the year to the back of the FCU's or into spaces via Variable Air Volume boxes (VAVs), excluding Wing A areas which will be supplied at 18/20°C during summer when the internal temperatures exceed 26°C.

Fresh air will be ducted from the air handling units to the various areas via risers before running at high level below exposed soffit and terminate behind the FCU inlets/ VAVs or within ceiling voids of toilet areas. The primary fresh air supply and extract will be insulated.

Fresh air control to the various areas where there is variable occupancy levels will include carbon dioxide control (CO2) which will be located within the occupied space at 1600m AFFL. A minimum of 2 No sensors will be included per teaching space.

Variable Air Volume (VAV) and Constant Air Volume Boxes will regulate the amount of fresh air provided to the various areas. The VAV boxes will regulate the fresh air provision based on variable occupancy levels and by interlinking the control of this to the VAV boxes, which will in turn regulate the pressure in the respective supply ductwork.

By regulating and maintaining the set pressure in the ductwork the AHU fan speed will ramp up and down to regulate the pressure of the system. The extract rate will be directly related to the amount of fresh air supplied and subsequently will reduce proportionally to the supply volume provided to the space.

All the spaces will be slightly over pressurized by 5 %.

Similarly the CAV box will facilitate that a fixed amount of supply air will be supplied to areas with fixed amount of fresh air requirements such as the toilet areas tea points etc.

2.7 Toilet extract

Toilet areas will be provided with ducted extract system. The fans will be located within the existing Plant Rooms 1 & 2 on Level 11 and ducted to external.

2.8 Control System

The existing BMS system is Trend Controls.

A new Trend Control system will be provided delivered to the latest available product fully interfaced with the existing to control all new HVAC systems.

The new and existing will be viewed as one system and operate as one. Head end equipment of existing will be upgraded so it can facilitate receipt of information and data.

Metering and Sub-metering will be connected back to the UCL campus wider metering EMON System.

2.9 Soil & Drainage

Existing soil and drainage will be extended and modified to match the original design standards.

Condensate will extend into stacks via dry traps to ensure odours are not released via FCU drip trays.

Rain water pipe locations have been amended to match the new layout.

All sanitary drainage stacks stub stack shall be ventilated via vent pipe system.

2.10 Hot & Cold Water

Existing hot and cold water systems will be extended and modified to match the original design standards.

Pipe work will extend to local blending valves to ensure legionella control and correct temperature at draw of points.

Drinking water points will be taken from fresh water only and labeled accordingly.

Water will be subject to both Hydromag and UV water cleaning techniques.

The incoming main to each main to each block will be fitted with a major leak detection control valve to meet BREEAM requirements.

3.0 Electrical Services

3.1 Electrical Services

The building benefits from an extensive existing electrical infrastructure consistent with the generally high standard of this renowned Grade 2 Listed building.

The proposed works involve a new infrastructure to deliver reliable electrical services of current standard to the areas served.

The building services will designed to meet the building BREEAM Employers Requirements Targets.

3.2 Incoming Services

The UCL building benefits from two utility network HV electrical supplies which enter the building via the level 2 service road.

These in turn to extend low voltage supplied via primary and secondary distribution switchboards.

Power is then extended through the three central cores A, B and C via bus-bar rising main bus bars to serve general lighting and power distribution to all the floors.

Rising main will be provided for Core A & B. Core C rising main busbar will be installed as part of Phase 3 works. All these rising mains will be a 4 pole aluminium busbars.

Each floor in each core A, B and C including respective wings are fed via local combined Lighting and Small Power distribution boards which are fed via a dedicated tap off from the rising main busbar.

3.3 LV Distribution

Secondary Low Voltage distribution will be located within each floor and dedicated electrical board within all floors

A new Mechanical Control Panels CC) will be installed within the Plantroom 1, 2, 3, 5 and 6.

Lighting and small power distribution boards will be installed within each refurbished area as indicated on drawings.

Metering will be provided at each distribution board to meet the requirements of The Building Regulations Part L.

All distribution boards will comply with BS 5486 and BS EN 60439 generally as surface mounted units.

3.4 Lighting

Interior lighting will be provided in accordance with British Standards the CIBSE Code for Lighting Guide LG5 and all relevant Education Standard Building Bulletins.

Luminaires will be of the suspended/recessed LED linear type positioned to afford best use of daylight.

The luminaires will be provided with LED sources to ensure Building Regulation Lumen/Watt efficiencies are achieve with consistent colour rendering.

3.5 Emergency Lighting

A comprehensive emergency lighting system will be provided to meet BS: 5266 and associated design standards.

In places of public assembly maintained illumination will be provided elsewhere the system will be non maintained.

All emergency lighting will provide 3 hours of standby operation in the event of mains failure. Local battery pack / inverter units will be provided. The associated battery/inverter, luminaire and LED control gear will be located adjacent the respective luminaire.

An addressable emergency lighting self testing system will be provided derived from the UCL approved manufacturer's list utilizing the UCL's procurement policy.

Exits and Exit routes will be both highlighted and identified by back lit emergency exit signage. These will match the Pictogram policy of the UCL estate to form a consistent campus wide approach.

3.6 Lighting Control

A comprehensive Lighting Control System will be provided for the new areas of internal lighting.

The system will be capable of remote interrogation via an IP protocol.

Lighting will be automatically controlled and dimmable through a DALI protocol. This to regulate the illumination levels of the various spaces in line with BS EN 12464. The final operation and control matrix will be agreed with Employer during the commissioning stage.

The illumination systems will be provide pre-set scenarios and have daylight linking.

When the building is unoccupied and is beyond the predetermined time, all lighting shall be automatically switched off. This with the exception of pre programmed police lighting which will deem to a minimum illumination level to allow security to continue during out of hours.

Small offices will have a wall mounted dimmer switch by each point of entry.

Within service areas the following Lighting control will be provided again utilizing the addressable system as follows:-

- Plant rooms — Local switching
- Store rooms — Presence Detector with Timed Run On
- WC areas — Presence Detector with Timed Run On
- Staircases — Presence Detector with Timed Run On

Internal lighting will be zoned to allow for occupant control in accordance with the criteria for relevant areas present within the building.

3.7 Small Power

Mains Power will be provided throughout each area for the following services:

- Small power outlets
- Supplies to fixed items of equipment
- Supplies to mechanical services

All socket outlet and accessory face plates used on the installations will match the respective lighting switches.

Final circuit cabling will be carried out as detailed on the circuit schedules.

Circuit supporting fixed equipment will be dedicated and not support other loads.

3.8 Containment Systems

Primary containment will be provided throughout the building to accommodate all systems as indicated on the containment drawings.

Containment will generally comprise of cable trays, cable baskets, trunking and conduit.

The horizontal routes will generally follow the main corridor runs and circulation spaces where possible.

Containment will be provided as follows for the following distribution networks:

- Sub-main Low Voltage Distribution: Galvanised steel cable tray
- Data: Cable basket
- Fire Alarms, BMS and security: Galvanised steel trunking
- Small Power and Lighting: Galvanised steel trunking
- Mid and Low Level Power inc data: High Impact plastic dado trunking
- Single point services HG Screwed steel conduit – Galvanised on Surface and black enamel when recessed.

3.9 Induction Loop System

An induction loop systems will be provided to the following areas:

- Main Reception

The system will be designed and installed to conform with BS 7594 BS 6083 IEC 118 Part 4.

3.10 Fire Alarm System

A new fire alarm installation with enhanced voice alarm sounders will be installed in the new refurbished space.

The system will be designed and delivered to BS 5839 latest edition. As defined therein the specialist contractor will take full responsibility for the design, selection, installation, testing and commissioning and provide associated single point of certification.

The fire alarm category will be L1 subject to an agreement with UCL Fire Officer.

Wiring will be a Hard skinned “enhanced” cable as Prysmian FP Plus (Sheath colour red) as manufactured by Prysmian Cables & Systems.

3.11 Voice Alarm System

A comprehensive voice alarm system will be provided conforming to BS 5839.

A combination of voice and tone sounders will be used in all areas where the public or large numbers of students use the space.

As defined in the UCL fire and emergency evacuation strategy phased evacuation will be provided. This shall further cater for the need to differentiate buildings as required.

Wiring system, containment, design and delivery responsibility will match that set for fire detection systems.

3.12 Data Transmission and Communication Systems

The data installation will be provided from dedicated communications rooms and will be distributed horizontally within a dedicated cable containment system. Details of the communications room’s requirements, including server room sizes, cooling requirements and electrical loads, will be provided by UCL ISD.

The system will comprise a network of outlets located around the refurbished building for the connection of Voice, Ethernet Data, Video Communications and CCTV.

3.13 Access and Security Systems

A comprehensive access control and security system will be provided to meet British Standards and Insurer Requirements. The system will be provided as per requirements set within UCL Document

It will comprise the following sub systems to meet UCL Employer Requirements as follows:

- Proximity access control
- Audio Visual Entry phone
- Intruder alarm
- Turnstile control

The system will further be designed to conform to all latest relevant standards and specifically to meet UCL's "Specification for the Installation of turnstiles and their integration with UCL's Card access control system"

The system will be fully integrated into the existing UCL systems so that its cause and effect are consistent and equivalent.

3.14 Earthing , Bonding and Lightning Protection

Earthing and bonding system will be provided to protect the building and their integral equipment to meet the latest requirements of British Standards.

The provision will include the earthing and bonding of all metalwork associated with the electrical installations including:

- All metal cable sheaths
- Cable armouring
- Metal conduit
- Trunking, Tray and similar equipment
- Mechanical services
- Public health services
- Structure
- Fixed equipment

Roof exposed mechanical plant will be bonded via proprietary pvc colour coded sheathed aluminium earth tape to the existing roof lightning protection system.

Electrical systems extending to roof and from power sources will be provided with electronic surge and spike protection to meet British Standard recommendations.