Client:-
PRIVATE CLIENT

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ENVIRONMENTAL CONTROLS

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ENVIRONMENTAL CONTROLS

13.1 System Overview

This section of the work is to incorporate the design, supply, installation and commissioning of the Environmental Controls and shall require a BMS Specialist to be employed by the Mechanical Subcontractor.

This Environmental Primary Controls System is to be interfaced with the AV System being provided by the client's appointed AV Specialist, McAllister

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"The system in brief will control, via a series of room controllers (to client requirements), room Temperature, heating and cooling with a soft interlock between to ensure that there is no heating being provided whilst cooling is called for and vice-versa, together with control of other 'non-services' functions. It shall incorporate a limited function UPS as detailed below.

The Mechanical Subcontractor shall incorporate within their tender the design, installation and commissioning costs associated with the 'BMS Controls Specialist' as detailed below.

The system requirements are to provide a seamless interface for the occupiers of the property to enable the control of the environmental systems, i.e. Heating, Hot Water, Ventilation Systems and Comfort Cooling.

13.2 Technical Submittal

The selected BMS Controls Specialist shall submit a Technical Submittal with technical data sheets for all of the products selected that shall form part of the system within the Tender submission complete with Points Schedule. (An example Points Schedules is shown in Appendix A).

13.3 General

The ***BMS*** control system is to be fully compatible with the ***AV system***. The Primary Controls system is to control Primary Heating/Hot Water Plant and associated Pumps etc. Demand For Room Heating/Cooling shall be as signalled /called for by the ***AV*** system, with Underfloor Heating Manifolds and underfloor sensors and air sensors within each room being part of the BMS Control System (Not the AV System).

The AV Specialist System will only communicate a signal to the BMS Control System advising an increase or decrease in room temperature is required. The BMS System shall manage all systems including Ventilation MVHR Units and Comfort Cooling Systems which shall be shut down in the event of a fire condition.

The BMS system shall be capable of providing a 'required temperature' signal/set point as an alternative to the AV signal for the purposes of system commissioning (if AV system is not operational) or as a back-up control method if the AV system is out of service.

The BMS system shall be include an Uninterruptible Power Supply (UPS) with sufficient capacity to keep the BMS master panel energised during a short power failure (up to 10

minutes) and before shutting down to transmit power fail & critical alarms messages to no fewer than 3 mobile phones.

Thermal and fluid design parameters are as given elsewhere in the relevant particular specification sections in this document.

In the absence of any overriding specification requirement detailed within this specification the following documents shall be deemed to form the specification for the control system:-

1) BSRIA Application Guide AG2/94 “BMS Performance Testing”
2) BSRIA Application Handbook AH2/92 “Commissioning of BMS – A Code of Practice”
3) BSRIA BMS Centre Application Handbook AH1/90 Volume 1 “Centre Standard Specification”
4) BSRIA BMS Centre Application Handbook AH1/90 Volume 2 “Standard Specification for BMS Version 3.1
5) CIBSE Application Manual Automatic Controls

A Control panel shall be installed in a suitable location as shown on the Tender Drawings allowing for adequate cable/maintenance access. All bus and mains cables shall be clearly labelled at the panel end using a suitable cable marking system.

13.4 Design & Layout

The following sections set out the design and installation ***principles*** for the Environmental Control system. The Specialist shall be responsible for the final systems design and detailing ensuring that the system meets the requirements of the M&E design.

The Controls Specialist shall make provision for the MCCP Plant Room Panel to include outgoing circuits for at least the following equipment (it being noted that some of these do not need controlling, but are to be included as part of the overall electrical distribution design).

The electrical design depends on the application of earth leakage protection (provided on the cable serving the MCCP and involving sensitivity and time delay of 3 Amps and 0.25 second respectively) and assumes the individual protective devices will be 10kA MCBs (miniature circuit breakers) to BS EN 60898 Curve C. Should there be reason why the arrangement should be otherwise, the Controls Specialist shall notify the M&E Subcontractor and the Engineer, and shall submit his proposals for review.

Circuits to be provided at MCCP (refer to the relevant pages of IC-01016-D9 for ratings) shall be (minimum);

- 1 TPN cold water booster pump supply
- 1 SPN MVHR unit
- 1 SPN Boot Room Extract Fan
- 1 SPN DHWS primary heating pump
- 1 SPN Calorifier Destratification pump
- 1 SPN Gas solenoid supply
- 1 SPN LTHW Towel Rail Heating pump
- 1 SPN LTHW Underfloor Heating pump
- 1 SPN DHWS secondary heating pump
- 2 SPN Boilers/sequencer/integral equipment
- 1 SPN Pressurisation Unit
- 3 SPN Immersion Heaters
- 1 SPN Water Softener

- A double 13A switched socket outlet.

13.5 Mitsubishi Comfort Cooling & Heating system

The comfort cooling (and back-up heating) system shall be based around a Mitsubishi VRF system as described within the Mechanical Specification. The system shall be supplied as a complete package by the Approved Contractor with all associated controls and equipment necessary to deliver a fully functional system. Comfort cooling temperature control shall be via central ***'AG150'*** controllers with interface to ***the BMS' and through it to*** the AV system. The AG150 controllers shall monitor and control all functions of the VRV connected systems and shall provide ***basic*** control ***(at agreed default settings)*** for all systems in the event of the House ***BMS or AV system*** failure.

13.6 Heating & DHWS

The CHP unit and Gas Boilers are the source of heat for the underfloor heating/DHWS systems. The CHP unit shall be configured as the lead heat source in line with SAV recommendations. The boilers shall be sequenced to meet heat demand and to rotate the 'lead' of the two boilers. The sequencing of the boilers may be via a Broag Remeha Boiler Sequencing Controller. The controls specialist shall confirm this requirement with the heating contractor prior to ordering of the boilers.

The Primary controls system shall be provided as a complete controls system to control and monitor the Primary mechanical plant and equipment.

13.7 Primary Controls

The Primary controls package shall include all Outstation, wiring, interface units, engineering, programming etc. to provide a complete controls system to meet the requirements for the mechanical items of equipment.

The mechanical systems to be controlled comprise:-

- Primary Heating via Gas fired CHP unit and Boilers feeding Pool Plant, Pressurisation Unit Pumps etc,
- Primary Heating for Under Floor Heating & Circulating Pumps.
- Secondary Heating for HWS Calorifiers and Under Floor Heating & Circulating Pumps from Gas Fired Boilers.
- Optimised time control, self learning for heating.
- Calorifiers, Booster set, water conditioner & HWS re-circulation pump.
- MVHR unit (via integral independent controls) shall provide supply and extract air for the occupancy load to the various building areas; this is to be run on a continuous basis.
- Kitchen extract air fan, filter monitoring by the appointed Kitchen specialist.

- Intermittent extract fans throughout the building shall operate via local control (PIR plus manual override).

  (Please refer to Mechanical Schedules/System Schematics for exact details of plant and where the run and standby pumps etc are being provided.)

All items of plant shall be provided with a means of local electrical isolation, if not integral with the equipment these are to be supplied and installed by the Electrical Subcontractor, in the form of rotary isolators, which shall be adequately labelled and secured adjacent to the equipment served. All Field Power wiring from the Control panel shall be supplied and installed by the Controls Specialist Contractor.

The controls specialist shall work in close conjunction with the ***AV*** Specialist and Mechanical and Electrical Subcontractors to ensure that a fully operational system is achieved for project completion. A system controls philosophy shall be submitted for approval prior to installation of any equipment.

The controls package shall include all wiring, interface units, controllers, engineering, programming etc. to provide a complete controls system to meet the requirements for these items of equipment.

The system shall be fully integrated via a gateway to the ***AV System***; all Room Temperature control ***set-points s***hall be provided through the AV System.

13.8 Plant – Description of Operation

13.8.1 LTHW System

Actuation of the Primary Heating system shall be by a weather compensation/optimum start routine.

CHP/Boiler start up shall be sequenced as follows:-

- The specific requirements of the SAV CHP unit operation, together with incorporation of the SAV buffer vessels, take precedence over control requirements of boiler etc.

- The primary and at least one of the secondary circulation pumps shall operate, and be proved operational by their respective differential pressure switches, before the boilers fire.

- Failure of the CHP/boiler in lead shall initiate the lag boiler, with the appropriate alarm being transmitted to the local MCC. On shut down of the boiler the boiler primary circulation pump shall continue to run for a period of 10 minutes (adjustable) to dissipate any residual heat from the boilers.

- All boilers and pumps shall be shut down in the event of a fault on the low temperature hot water system pressurisation unit.

- CHP unit shall be constant ‘lead’. Subsequent boilers are to be sequence controlled by the Boilers Sequence Controller.

- When the CHP/boilers are not energised and there is no demand for heating, the boiler primary pumps are to be disabled.

- When the heating pressurisation unit high, low or lockout heating alarms are active the CHP & boilers are to be de-energised and an alarm raised to the control system and on the ***AV*** System.

- CHP unit & Boilers are to shut down on, first stage gas detection alarm, boiler room panic button activation or fire alarm activation. The gas valves to the respective gas inlet manifolds shall also be shut down

The Controls Specialist shall liaise with the CHP unit & boiler manufacturers to ensure full compatibility of the boiler controls with the overall control system.

Power supplies to the CHP, Boilers and pumps shall be provided within the Control Panel Power Section with all necessary starters/thermal overloads.

Each CHP & Boiler shall have a hand off auto control as part of its supply; this shall be retained so as not to void any manufacturer's warranty.

The flow water temperature from the CHP/boiler system shall be controlled at 80°C. This shall be achieved by means of a temperature detector located in the common flow pipework, connected to the (BMS) outstation (with proportional and integral control) whose output signals shall be arranged to provide 0-10v modulating control of each burner.

The sequence of operation shall be such that upon a fall in the detected flow temperature the boilers shall be arranged to fire in the following order:

- Allow the CHP unit to run at the dictates of its own control system.

- Allow the Boiler Nr 1 to fire at the dictates of the boilers own control thermostats.

- Allow the Boiler Nr 2 to fire at the dictates of the boilers own control thermostats. Etcetera.

On rise in flow temperature the reverse sequence shall occur (i.e. CHP shuts down last.

The boilers own control thermostat shall be set up at a value to provide the desired mixed flow condition (80°C) under half load conditions.

Upon CHP/boiler start up all units shall be arranged to operate until the required water flow temperature is achieved and then sequence down accordingly so that a steady water flow temperature is maintained under the dictates of its own sequencer.

A hard-wired interlock shall be provided within the control panel to prevent any of the boiler modules from operating unless the selected duty heating pump is running, water flow is present and the pressurization unit is healthy.

This shall be achieved by means of a water pressure switch located across the main heating pumps which shall also be arranged to initiate automatic changeover of the pumps.

The common return temperature for the heating system shall be monitored within the (BMS) system. This shall be achieved by means of a suitably located temperature sensor in the common return pipework which shall be arranged to detect 'out of limits' alarms and generate an alarm condition at the central (BMS) facility.

The heating system shall be controlled on an optimum start/fixed time off / demand program. The optimum program shall be arranged to compare the average inside and outside air temperature with historical data complete with the following essential (BMS) functions.

Indication of 'CHP/Boiler High Temperature Trip' and 'CHP/Boiler Lockout' shall be provided at the local panel and on the (BMS) system. These alarm contacts shall be derived from the Units own integral control circuitry and the Automatic Controls Specialist shall be responsible for liaising with the boiler manufacturer in order to achieve these functions.

13.8.2 Pumps

The pumps shall be enabled first under the dictates of the (BMS) optimum time program in combination with any heating valve or circuit demanding heating. Once enabled and flow proven the CHP/boiler plant shall run.

Minimum features shall include:-

- Self adapting 'Optimum On' related to inside and outside air temperature.
- The outside air temperature sensor shall be located to the north face of the building.
- Fixed time 'Off' program.
- Choice of one of two optimised occupancy periods for each of the seven days in a week (independently).
- Manual program override switch.
- Boost termination (hold compensated slope fully raised until target space temperature is achieved).
- The Underfloor heating circuits shall operate even if the outside air temperature exceeds 20 °C, Bathroom and wet room shall operate as shall the towel rail circuit.
- Two stage frost protection (minimum night inside temperature) arranged to operate boilers and pumps as detailed below:-

  Stage 1 - When outside air falls below preset limit open all control valves and start up all heating pumps.

  Stage 2 - When inside air falls below a preset limit start up the boilers (lowest of room sensors), enable the main air handling units and initiate the perimeter heating control circuit.

13.8.3 Variable Flow Constant Temperature Heating Pumps

Variable flow constant temperature pumps shall be arranged as 2 No. duty and standby pumps to circulate LTHW to the appropriate air handling units heater batteries, Underfloor Heating and a dedicated Towel Rail circuit.

Each pump shall have an integral inverter unit located on the pump. Each inverter shall have Local/Off/Auto selection integral with the inverter unit.

Each inverter shall be electrically powered from the Control Panel within the plant room by a suitably power supply.

When the selector switch for the PWM inverter is in the 'Auto' mode the software selected duty pump shall be arranged for variable flow control and automatic changeover in the event of loss of water flow as detected by the pressure switch and inverter overload trip condition.

A common pump fault indicator lamp shall be provided at the control panel derived from a pressure switch across the pumps and fault signal from the inverters. All necessary inhibit and delay timers shall be provided within the software in order to avoid false indication of 'water flow failure' during automatic changeover of the pump set or upon initial start up of the pumps. Duty load sharing of the constant temperature pumps shall be provided on a 300 (adjustable) hours run time basis through the (BMS).

A pump run-on timer shall be provided within the software to allow the duty pump to 'run on' for a fixed period after the plant is 'timed off' in order to dissipate the heat within the respective boilers.

When the PWM inverter is in the 'Hand' mode the selected duty pump shall run continuously at a pre-set speed and shall not be controlled at the dictates of the (BMS) system or arranged for automatic changeover. An interlock shall be provided to ensure that if both pumps are selected in 'Hand' only one pump will run.

Pump 'Run', ‘fault’ and not set in ‘Auto’ indication shall be provided on the (BMS) for each pump, derived from the PWM inverters own control circuitry together with water flow failure.

A feedback signal from the inverters shall also be connected into the (BMS) outstation to provide analogue indication of motor speed at the central (BMS).

The selected duty pump shall be arranged for variable speed control by means of a PWM inverter located adjacent to each pump. A constant pressure differential shall be maintained between the flow and return circuit of the system. This shall be achieved by means of a suitably positioned pressure detector located across the flow and return pipework connected to the (BMS) outstation in the appropriate control panel whose analogue output shall be arranged to vary the speed of the selected duty pump accordingly, thus maintaining the same differential pressure at the detector position at all times.

13.8.4 General

Provide differential pressure switches across all pump sets to transmit pump run and trip indication at the Control Panel and to the control system.

On failure of the duty pump in each twin pump set (monitored by a differential pressure switch), automatic changeover to the standby pump is to be initiated and an alarm shall be raised at the Control Panel and to the ***AV*** system.

The LTHW heating system is to provide frost protection, initiated in two stages as follows:

First stage frost protection is to activate all primary and secondary pumps should any internal space temperature sensor or roof top plant room temperature sensor drop below 10°C.

Second stage frost protection is initiated when any heating system immersion temperature sensor drops below 5°C.

Under second stage frost protection, the lead boiler is operated and continues to run until the water temperature increases to 7.5°C at which time the boilers are to be shut down.

Each of the set points for first and second stage frost protection routines is to be site adjustable via the control system in the range 0 to 20°C.

13.8.5 Pressurisation Units

The entire heating system is pressurised by a packaged pressurisation unit and expansion vessels which is enabled by the Control Panel.

When the pressurisation unit, high low or lockout alarm is activated the boilers are to be prevented from starting (or de-energised if already in operation) and an alarm shall be raised at the Control Panel and to the ***AV*** system.

13.8.6 Primary Heating

Each constant volume, constant temperature primary heating circuit is activated whenever its respective circuit is called upon to operate.

Low temperature hot water (at a flow temperature of 80^{o}C and a return of 60^{o}C) is supplied to the primary circuit from the central CHP/boiler plant which operates under the following control strategy to produce heating water at the designated temperature.

Provide and install primary heating pumps to interconnect each of the CHP unit & 2 No. boilers with the common low pressure loss mixed flow header arrangement.

On a call for heating to start up and providing no alarms from gas leak detection, fire detection or pressurisation unit are active, the respective primary heating pump will be started.

Pump flow failure is monitored by a differential pressure switch as indicated above.

The CHP unit shall remain as the lead heating provider, and the boilers shall be sequence lead/lag controlled, and individual burners shall modulate, to maintain the required constant primary flow temperature in the common flow header.

The CHP & boilers shall be connected to primary low loss headers. They shall operate to provide the main heating to the low loss header. Each CHP & boiler shall be provided with pumps, as per the schematic drawings, and shall maintain the primary heating temp of 80-60^{o}C.

The low loss header shall provide, via pumped circuits, heating to the pool water & air systems, heating to the UFH system via a 3 port mixing valve, heating to the towel rails via a 3 port mixing valve, and a pumped circuit to the domestic hot water heating calorifiers.

Start/stop times for the heating plant shall be dictated by an optimum start programme resident within and controlled by, the control system. The optimiser shall refer to outside air temperatures, internal air temperatures and historical data to derive the optimum start times for heating plant. The flow temperature to the UFH manifolds shall <u>not</u> be weather compensated and shall remain at a constant flow temperature of 50^{o}C.

On CHP/boiler shut down when there is no further demand for heating, the boiler primary pump shall continue to operate for an adjustable time period of up to 20 minutes in order to dissipate any residual heat from the boiler before shutting down.

The control shall provide a rotational duty sequence for the 2 boilers to ensure equal use of ***the plant and all pumps***.

CHP & boilers and associated heating pumps are to be shut down on any of the following:-

1. Gas leak detection system energising
2. Second stage gas detection alarm.
3. Local fire alarm activation.

In the event of any of the above then the Gas Solenoid Valve shall be shut.

13.8.7 Secondary Heating (VRF system)

Secondary (back-up) heating is provided by operation of the VRF fan-coil system in 'heating' mode.

13.8.8 Underfloor Heating

The underfloor heating system shall consist of dual secondary heating pumps and a 3 port mixing/injection valve (in the plant room), together with a series of pumped manifolds with 3 port temperature control valves & zone control valves local to each manifold. The plant room 3-port valve and controls shall control the UFH distribution system at a flow temperature that does not exceed 65^{o}C and a return of 45^{o}C (adjustable). In the event of the temperature being exceeded the boilers shall be shut down, the 3 port valve shall be closed to the CHP/boiler system and an alarm shall be raised at the BMS head end.

Each UFH manifold 3-port valve and local controls shall control the UFH manifold flow temperature at 55^{o}C and a return of 45^{o}C (adjustable). ***An immersion type electronic temperature sensor shall be installed at each UFH flow manifold, as a safety back-up, wired to shut down the manifold circulation pump if the flow temperature exceeds 57^{o}C (adjustable).***

The room temperature sensor associated with each zone (room) shall control the associated zone control valve at the manifold. ***The floor temperature sensor associated with each zone (room) shall override the operation of the associated zone control valve at the manifold if the underside of the floor finishes exceed the approved maximum temperature (e.g. 29^{o}C adjustable).***

The controlling of the respective room zone heating systems and the respective manifold pump set shall be monitored and controlled by the BMS system utilising temperature inputs etc from the AV system.

The local floor control will be by means of a multiple circuit manifold, which will be supplied as a package by the underfloor heating contractor. The BMS system will enable and monitor the local controller for the manifold operation. Should a fault be raised on the local controller this will also raise an alarm on the BMS system.

13.8.9 Towel Rail Circuit/s

The Towel rail circuit comprises an adjustable constant temperature circuit fed via a 3 port temperature control valve and adjustable flow temperature sensor from the low loss header and shall circulate at 50°C flow 40°C return. The temperature of the towel rail system shall be adjustable to suit the requirements/preferences of the user.

The towel rail system controls shall provide for timed operation of towel rail heating on a daily basis (7 days per week) with potential for no less than three operations per day.

13.8.10 Domestic Hot Water

Primary LTHW flow temperature to the calorifiers shall be 80°C, and return shall be 60°C.

Hot water storage temperature is to be controlled at 60°C ($^{+}/_{-}$ 2.5) for 24 hours per day, 365 days per year, this is to be achieved with the primary source, to bring the temperature to 60°C, being from the gas Boilers. There shall also be provision within the DHW control system to provide timed operation of calorifier heating on a daily basis (7 days per week) with potential for no less than three operations per day.

Hot water storage calorifiers shall be controlled by a three port control valve in the LTHW flow to the calorifiers, to be operated by means of a temperature sensor monitoring the stored secondary hot water temperature to maintain $60^{+}/_{-}$ 2.5° C.

The Controls Specialist shall provide in addition to the normal temperature control above, a high temperature control interlock to isolate heat input upon the stored water temperature reaching 65°C, by means of a two port fail close control valve and dedicated high limit temperature sensor.

The high temperature device is to be independent to the normal temperature control system and is to be manually resettable.

The sensors and control system are to be capable of enabling the system set points to be altered to achieve a 70°C system water temperature at the main boiler plant, on certain occasions when required by the user, to enable pasteurisation of the system.

Each hot water cylinder heat exchanger shall be provided with a 2 port motorised valve to control the required storage temperature.

The DHWS (secondary) circulating pump is to operate under the control of the BMS. Pump operation is to be linked (by the BMS controls) to heating of the calorifiers by either the CHP/boilers or the back-up immersion heaters such that circulation of DHW does not take place if heating is not available to the calorifiers.

13.8.11 Water Softener

A water softener shall be supplied by the Mechanical Subcontractor; this shall be monitored for low salt & fault etc by the BMS Outstation.

13.8.12 Pool Heating

Heating to the Pool water and air shall be provided via a dedicated constant temperature supply from the gas fired boiler system. The supply shall be fitted with a 3-port diverting valve that shall be interlocked with the pool heating plant to divert flow from the unit when heating demand is satisfied.

13.8.13 Fire Shutdown

An addressable Fire Detection/Alarm system shall be installed by the Fire Alarm specialist, an Input / Output module shall be provided adjacent to the Control Panel to provide a Fire Input to the Control Panel.

In the event of Fire Detection the Control panel shall immediately shutdown the Gas Fired CHP unit & Boilers and associated gas valves; other Input / Output Modules shall shut down the Whole House Ventilation/fan coils.

13.9 Controls Specialist

The Primary Controls Specialist shall design, supply and install controls to serve all other mechanical systems detailed in the Mechanical Specification and associated Tender Drawings. The design details and associated installation drawings shall be submitted to the client, or client's representative, for comment and approval prior to the commencement of any installation works.

A power supply shall be provided for the Control Panel which is to serve/provide control/power to serve all Primary mechanical systems including those mentioned above, to be served by the System. The Primary Controls Specialist ***shall install and*** connect all ***power and*** control components /sensor cabling/sensors/actuators etc. associated with these systems.

13.10 Energy Metering, Recording and Processing

13.10.1 Introduction:

The Controls Specialist shall design, install, commission and provide training for a metering and energy monitoring system as described below for the purposes of:

- Recording meter readings for electricity, gas and water consumption for the property, including heat and power contributions from a CHP plant, and for possible connection to a future district heating scheme.
- Processing & summating meter advances and producing reports on the energy and water consumption so that (for each service) periodic usage and patterns can be identified and comparisons made, the aim being to help the Employer in his attempts to control or reduce his ongoing energy and water consumption (and so he can demonstrate the efforts he is making to manage the property).

It is envisaged that the Controls Specialist will enlist the help of an Automatic Meter Reading specialist firm (eg MWA Technology, Birmingham).

The primary aims of the metering/reporting system shall be:

	Electrical energy	Gas consumption energy	Water consumption	CHP plant energy
1	Identify Utility infeed vs CHP generation, & split use between lighting, small power and mechanical equipment/plant.	Identify and split use as CHP vs balance of house vs BBQ.	Identify and split use as house vs garden.	
2	Permit period checks against	Permit period checks against	Permit period checks against	

	Utility billing (eg monthly)	Utility billing (eg monthly)	Utility billing (eg monthly)	
3	Permit periodic analysis (eg annually) and benchmarking	Permit periodic analysis (eg annually) and benchmarking	Permit periodic analysis (eg annually) and benchmarking	
4				Permit periodic performance analysis (eg monthly & annually) of hours run, gas consumption, heat output & electrical output.
5	Avoid need for manual meter reading & arithmetic. Provide output to PC by spreadsheet or in other agreed format.			
6	Include facility for monitoring in at least 3 distinct times-of-day, separately adjustable for each service (to permit future analysis against multiple tariff time slots). Include facility for identifying/adjusting for meter replacement and for entering manually meter readings if so required. Include facilities for hand-dressing Gas calorific values. Allow for hand-dressing the area & volume of the House, for purposes of bench-marking where square metre or cubic meter comparisons may be desired.			
7	Provision for future District Heating; Aims similar to above, but with inputs from Heat meter or from flow meter + hand-dressed calorific values.			

13.10.2 Metering arrangements:

The various M&E system designs include an element of sub-metering, as depicted on the issued mechanical and electrical schematics. The Controls Specialist may propose additional metering points should these be necessary for the scheme he proposes, in which case his price shall be deemed to include for supply & installation of such additional meters.
The meters have been specified under the various M&E work elements with signal outputs envisaged as serial data channels (eg M-bus or Modbus) or impulsing contacts. Co-ordination of final signal types and impulse values shall be undertaken by the Controls Specialist with the respective mechanical and electrical subcontractors. (If the Controls Specialist believes there may be an overall benefit in selecting and purchasing the meters under his package instead, he may propose

such arrangement to the M&E Subcontractor for reassignment of purchase responsibility.)

The Controls Specialist shall be responsible for all interconnecting cabling, any communications interfaces and for commissioning of the recording system (in co-operation with commissioning of the physical metering points by the M&E subcontractor). The meters shall be connected via cable or wireless link to a summation and processing unit, envisaged within or adjacent to the BMS panel. Meters are shown on the various schematics, but cover basically the following. (The information on the schematics takes precedence however).

- Meters on the Electrical system:
  - Incoming Check meter – records energy & other parameters on the utility infeed
  - CHP Production meter – records site CHP generation (elec kWh)
  - Distribution meters at the main electrical panel board (8 x 3-phase meters & 4 x single-phase meters) – record energy to various load types: lighting, small power & mechanical plant.
- Meters on the Gas Supply system:
  - Incoming Check meter (impulsing) - records flow/volume for whole site utility infeed.
  - Distribution meter to CHP – flow/volume to CHP engine
  - Distribution meter to outdoor living (BBQ) – flow/volume to outdoor BBQ
  - By subtraction (no meter) – balance of gas used for heating.

- Meters on the Water supply system:
  - Incoming – no check meter – rely on facility for hand-entering Utility company meter readings.
  - Distribution feed to RWH – records water consumption for garden (top up of rain water harvest tank)
  - By subtraction (no meter) – balance of water used for domestic purposes.

- Heat meters
  - CHP Production – records site CHP generation (heat kWh)
  - Future District Heating infeed

13.10.3 Energy Monitoring & Report Requirements:

Energy & water meter readings should be transmitted/registered as far as reasonable in real time. (No objection will be taken however to delays of up to a few seconds introduced by polling of meters or by prioritising command/alarm traffic over meter reading traffic on shared communication or computing equipment).

The main purpose shall be to record & process energy (kWh), but it would be a benefit to the Employer if the system can derive/record demand figures too (i.e kW demand for the electrical installation and kW or peak flow rates for the gas installation).

The Controls Specialist shall supply and set to work a system which meets at least the primary aims tabulated above. He shall propose a data recording and manipulation software suite which may either be loaded onto a LAN connected

desktop computer on the site (to be supplied by the Employer, but which may be used for other purposes too) or may be located on a remote server and accessible over the internet (using security algorithms and password protection).

In addition the software shall include features/routines to

- Detect if communication has been lost to any meter, in which case an alarm signal shall be generated for the Household BMS (and communicated if necessary by a hard-wired relay)
- Check energy balances for the electricity network, (within the accuracy limits of the meters)
- Allow hand-entry of Utility meter readings and billing dates, calorific values, conversion factors for kWh to kg of CO_2 .
- Generate user data such as
  - share of electricity, & gas water consumption to the various use categories, in absolute quantities, equivalent kWh and percentage of incoming.
  - share of water consumption to the various use categories, in absolute quantities and percentage of incoming.
- Benchmarking information for the house as a whole such as: gas & electricity consumption in kWh/m^2 and in kg CO_2/m^2
- Maintain historical information for a minimum of 20 years

13.11 Miscellaneous Electrical Equipment monitoring:

The Controls Specialist shall allow for receiving logging and displaying alarms and status signals for sundry items of electrical equipment as may be identified in the Electrical works specification (document IC-01016-D6) or in the main contract works. He shall allow for transmitting any alarms agreed as critical to the AV system for display on touch-screens or for messaging to a mobile phone.

The requirements shall include but not be limited to:-

- ***Surge diverter operation (mains)***
- ***Power fail/isolation on circuit to Foul Water Pumpset***
- ***Power fail/isolation on circuit to Cavity Drain Pumps***
- ***Surge diverter operation (telecoms')***
- ***Alarm/overload on Foul Water Pumpset***
- ***Garden Irrigation Pump power switched to 'Off'***
- ***Security system fault condition***
- ***Fire alarm fault***
- ***Fire alarm detects fire condition***
- ***Metering alarm***

13.12 Control Panel

The required outstation, field mounted equipment, software and commissioning shall be supplied by Trend and utilise a standard IQ outstation. The main control panel shall incorporate a face mounted touch screen to enable investigative access to the system, at levels controlled by hierarchical passwords or other agreed means.

The Control Panel shall contain two segregated sections, Control and Power. The Gateway shall have an external Socket mounted to the control panel to enable connection to the AV System.

The Power section is to house all mcbs, starters/overloads, indicator lamp terminals. The control section is to house the outstation and required relays, and outgoing/incoming ***terminals*** of WAGO manufacture or equal and approved.

The minimum conductor size is to be 2.5mm^2 for power cables and 1.0mm^2 for control cables. All cables to be fitted with numbered colour coded ferrules and proprietary crimp connectors.

The supply of the control panel and all power and control field wiring is to be carried out by the Primary Control system specialist.

Wiring Diagrams

Before construction of any control panel commences, proposed design drawings shall be submitted to the Engineer for comment. These are to be, as a minimum:-

- Circuit diagrams showing schematically the power and control circuits in such a way that the sequence of operation can be determined. All wiring and terminal numbers shall be shown together with the last number used and any terminals omitted.
- An interconnection drawing detailing all interconnections between panel/Actuators/Sensors and connection to plant etc, including details of cable types/sizes number of cores and terminal numbering.
- Panel layouts showing all components mounted within the control panels.
- Fascia layouts and label schedules.
- Sequence /logic charts on diagrams showing control loops.
- A parts list scheduling all equipment within control panels and supplied for field installation.
- Any other drawings and schedule required for a complete installation.

13.13 Installation & Cabling

The installation of all mains cabling shall be carried out in accordance with the Electrical specification.

The Installation of the system, including cabling and the main controller etc., shall be carried out by the Controls Specialist in accordance with the manufacturer's standards.

In accordance with the Electrical specification only low smoke and zero halogen cable may be used on this project. Segregation is to be ensured throughout the installation ***to keep power cables separated from communications/data/AV cables by at least 300mm.***

13.14 Programming & Commissioning

The system shall be commissioned by the Primary Controls Specialist on site. Commissioning procedures shall be carried out in accordance with the guidelines of the manufacturers and in accordance with Section 13.3 above.

The commissioning process shall include full functionality checks of all system components, gateways/interfaces and control strategy.

13.15 Final System Adjustments

The Specialist shall allow ***to*** return to the property after the commissioning handover and during the occupation of the new owner, to adjust the system and make any minor owner alterations. This visit shall also form part of the training for the owner.

13.16 Handover Documentation

The Specialist shall be required to handover 'as installed' record drawings and documentation upon the completion of the work or as detailed within the contract. Full operating and maintenance manuals shall be provided in accordance with the contract specification. The following record documents shall be provided by the Specialist and left with the Client and or property owner:-

- Technical data sheet for all products information/schedules.
- Systems description & control matrix basic systems instruction sheets.
- Any other relevant handover documents.

Appendix A – Example [indicative] Points List

The appointed controls specialist shall submit, for comment and approval, their full point's schedule. As per the enclosed indicative sample.

MCC- 1	Point	DO	DI	AI	AO	CI
	Fire alarm activated		1			
	Common Flow Temp			1		
	Common Return Temp			1		
	Boiler 1					
	Boiler no.1 Enable	1				
	Demand signal				1	
	Fault		1			
	Flow Temp			1		
	Return Temp			1		
	Boiler 2					
	Boiler no.2 Enable	1				
	Demand signal				1	
	Fault		1			
	Flow Temp			1		
	Return Temp			1		
	Boiler 3					
	Boiler no.3 Enable	1				
	Demand signal				1	
	Fault		1			
	Flow Temp			1		
	Return Temp			1		
	Boiler 4					
	Boiler no.4 Enable	1				
	Demand signal				1	
	Fault		1			
	Flow Temp			1		
	Return Temp			1		
	Gas Detection					
	Fault		1			
	Alarm		1			
	Primary LPHW Pumps					
	Boiler 1 Primary Pump					
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Pump no.2 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			

	Pump 2 Kwh					1
	Pump DP switch		1			
	Boiler 2 Primary Pump					
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Pump no.2 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 2 Kwh					1
	Pump DP switch		1			
	Boiler 3 Primary Pump					
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Pump no.2 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 2 Kwh					1
	Pump DP switch		1			
	Boiler 4 Primary Pump					
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Pump no.2 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 2 Kwh					1
	Pump DP switch		1			
	AHU & FCU Secondary					
	AHU & FCU Flow Temp			1		
	AHU & FCU Return Temp			1		
	System differential pressure			1		
	Differential pressure valve				1	
	Pump enable	1				

	Demand signal				1	
	Speed f/b			1		
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump Kwh					1
	AHU & FCU Secondary					
	Pump enable	1				
	Demand signal				1	
	Speed f/b			1		
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump Kwh					1
	AHU & FCU Secondary					
	Pump enable	1				
	Demand signal				1	
	Speed f/b			1		
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump Kwh					1
	DHW Primary					
	DHW Flow Temp			1		
	DHW Return Temp			1		
	Pump enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump Kwh					1
	DHW Primary					
	Pump enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump Kwh					1
	Pool Primary					
	Pool Flow Temp			1		
	Pool Return Temp			1		
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1

	Pool Primary					
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	FCU Secondary					
	FCU Flow Temp			1		
	FCU Return Temp			1		
	System differential pressure			1		
	Differential pressure valve				1	
	Pump no.1 enable	1				
	Demand signal				1	
	Speed f/b		1			
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	FCU Secondary					
	Pump no.1 enable	1				
	Demand signal				1	
	Speed f/b		1			
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Underfloor Secondary Pump					
	Flow Temp			1		
	Return Temp			1		
	System differential pressure			1		
	Differential pressure valve				1	
	Injection valve				1	
	Pump no.1 enable	1				
	Demand signal				1	
	Speed f/b			1		
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Underfloor Secondary Pump					
	Pump no.1 enable	1				
	Demand signal				1	
	Speed f/b			1		
	Inverter mode monitor (auto / manual)		2			
	Fault		1			

	Pump DP switch		1			
	Pump 1 Kwh					1
	Condenser PHX Secondary					
	Flow Temp			1		
	Return Temp			1		
	Pump no.1 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 1 Kwh					1
	Pump no.2 enable	1				
	Inverter mode monitor (auto / manual)		2			
	Fault		1			
	Pump DP switch		1			
	Pump 2 Kwh					1
	LPHW Pressurisation unit enable	1				
	LPHW Pressurisation unit fault		1			
	Gas Booster enable #	1				
	Gas Booster set fault		1			
	Gas safety circuit #		1			
	Gas valve shut		1			
	# gas boosters and gas safety circuit hard wire interlocked with boilers					
		27	**105**	**30**	**15**	**21**
	Total Points	**198**				