PROJECT NUMBER: 2752

SPECIFICATION FOR MECHANICAL AND ELECTRICAL PLANT REFURBISHMENT

PENLEE HOUSE GALLERY & MUSEUM

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ISO 9001 REGISTERED FIRM

REVISION DATA

Revision	Date	Author	Details	Approved
First Issue	07/03/24	Daniel Wood	Issued for Client Comment.	GPJ
A	17/07/24	Daniel Wood	Revised after Client feedback and technical review	GPJ
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C	24/09/24	Steve Sandercock Kennall Consulting	Removal if elements to include in Invitation to tender document and agreement of highlighted edits set out to version B	
D	05/09/24	Daniel Wood	Review and Modification	
E	09/09/24	Daniel Wood	Final Issue for Tender	GPJ

GPJ Consulting Engineers

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1.0 LOCATION OF SITE

The site is situated in the Town of Penzance, Cornwall

2.0 DESCRIPTION OF WORKS

- New Condensing Boilers
- New variable speed pumps for heating and cooling circuits
- New Pressurisation Units for heating and cooling circuits
- Revised Ventilation System
- 2 Port Valve Control
- New Dehumidifiers to assist with controlling environmental conditions
- New Building Management System

As well as the above works, the existing ventilation, heating, cooling and environmental systems will be recommissioned with new settings to further improve energy efficiency.

Provide Operating and Maintenance manuals, including all new equipment operating and maintenance instructions, and relevant new equipment servicing during the 12 month warranty period.

3.0 DRAWINGS

For drawings list, please refer to Part 4 Tender Drawing Schedule

The works shall be carried out in accordance with the directions and to the reasonable satisfaction of the Employer, in accordance with the drawings, specification and any such further drawings as may from time to time be given by the Employer.

4.0 OWNERSHIP OF DRAWINGS

All drawings, computer disks and electronic files, photo prints and writings (except letters) to be considered by all parties to be the sole property of the Employer and they are to be returned to the Employer on completion of the works.

5.0 ACCESS TO SITE

Access to the site will be agreed during the pre-contract meeting.

Any damage caused to the premises and surrounding area as a result of carrying out the works is to be rectified on completion of the works or immediately depending upon severity.

6.0 ARTICLES OF VALUE AND MATTERS OF ARCHAEOLOGICAL INTEREST

All articles of value, curiosities, coins, relics etc that may be found in excavating or alterations are to be the property of the Employer.

7.0 IMPORTED LABOUR AND DELAYS

The Contractor is to acquaint themselves with the conditions appertaining to the supply of local labour of all classes. The additional cost of importing labour in order to maintain progress is the responsibility of the Contractor.

The Contractor is held to be aware of unavoidable delays which may occur in obtaining delivery of materials and is to make due allowance for any loss they may sustain for reason of such delays and for any additional payments which may have to be made for materials in order to ensure delivery in time to allow the work to be completed by the stipulated date.

8.0 OVERTIME

No overtime shall be worked without the prior consent in writing by the Employer. Should such consent to any application be given, all consequential costs shall be borne by the Contractor.

9.0 SUPPLY EVERYTHING NECESSARY

The Contractor shall allow here for all costs or expenses in connection with the following:

Maintaining temporary works, adapting, clearing away and making good shall be deemed to be included within the items

9.1 Plant Tools and vehicles
9.2 Scaffolding
9.3 Site Administration and Security
9.4 Transport of Work people
9.5 Protecting the works from inclement weather
9.6 Water for the works
9.7 Lighting and temporary power for the works
9.8 Temporary roads, hard standings, crossings and similar items.
9.9 Temporary accommodation for use of the Contractor
9.10 Temporary telephones for the use of the Contractor
9.11 Traffic regulations
9.12 Safety and welfare of workpeople
9.13 Disbursements arising from the employment of workpeople
9.14 Maintenance of public and private roads
9.15 Removing rubbish
9.16 Drying the works
9.17 Temporary fencing, hoardings, screens, fans, planked footways, guardrails, gantries, etc
9.18 Control of noise, pollution and all other statutory obligations.

10.0 DRYING THE WORKS (WHERE APPLICABLE)

The Contractor is responsible for drying the works and is to allow for providing the equipment, fuel and attendance necessary in drying the works.

11.0 ATTENDANCE (WHERE APPLICABLE)

The Contractor to attend upon, cut away for and make good after (except where otherwise specified) all trades mentioned in this Specification.

12.0 PROVISION AND RESPONSIBILITY FOR THE SAFETY OF BUILDINGS ETC

Provide all necessary tarpaulins and other means of covering up for the protection of the works against inclement weather and make good all damage done.

The Contractor shall be responsible for the safety of the buildings (including plant, materials etc) until they are taken possession of by the Employer, and they shall stand at the risk and be in sole charge of the Contractor.

13.0 WELFARE

Comply with the safety and welfare measures required by enactment or regulation.

Comply with the Working Rules for the area as agreed by the Joint National Council for the Building Industry

Agree with employer to use sanitary accommodation in existence, as directed by employer, keep clean at all times, maintain on site, where directed, proper sanitary accommodation for use of workmen and keep in a thoroughly clean and sanitary condition for the duration of the Contract, and make good upon completion.

14.0 SAFEGUARDING THE WORKS

Safeguard the works, materials and plant against damage and theft, including providing all necessary watching and lighting for the security of the works and the protection of the public.

15.0 EXISTING SERVICES

Check for the existence of services in the area of the work and locate and mark. The Contractor shall be responsible for damage to services occurring as a result of the work in the Contract, and any consequential damage arising therefrom, and bear all costs in connection therewith.

16.0 MAINTAINING SERVICES

Allow for protecting, upholding, temporarily diverting and maintaining all pipes, ducts, drains, sewers, service mains, overhead cables and the like, during the execution of the works.

17.0 USE OF SITE

The Contractor shall not use the site for any purpose other than for carrying out this Contract, and must obtain the approval of the Employer for the siting of all sheds, offices, temporary spoil heaps, storage of materials etc, necessary for the execution of the works.

The Contractor must allow here, or include in their rates for all costs, charges and expenses arising in connection with access to the site, delivery and storage of materials in the prevailing conditions as no claim on the ground of want of knowledge will subsequently be entertained.

The Contractor must allow for making good all areas where sheds, offices, temporary spoil heaps etc have been sited. These areas are to be made good to the standard pertaining at the commencement of the contract.

18.0 PERSON IN CHARGE

The Contractor shall keep a competent person in charge on site. Where the Contract refers to "all reasonable times" these times shall be deemed to include all times when work is being engaged out by any person directly or indirectly engaged by the Contractor.

19.0 CONTRACTOR'S NAME BOARD AND ADVERTISING

Name boards are prohibited by the Employer **(TBC)**

20.0 TEMPORARY BUILDINGS

Provide, erect and maintain all necessary buildings, sheds, first aid shelters, mess rooms, and stores and pay all rates and taxes in connection therewith.

21.0 STABILITY

Accept full responsibility for the stability and structural integrity of the works during the Contract, and support as necessary. Prevent overloading.

22.0 DAMAGE BY FROST

During severe frost and in wet weather, the whole of the works shall be effectively protected.

23.0 SETTING OUT OF THE WORKS

Allow for being responsible for carefully ascertaining or checking dimensions and heights and levels, as indicated on the drawings and for the accurate setting out of the works as shown on the drawings. Any inaccuracies will be the sole responsibility of the Contractor and shall amend the work at their own cost.

24.0 COVERING UP

Give not less than 2 working days' notice to the Consulting Engineer before covering up the following:

1.0 Pipework with lagging or Boxing in
2.0 Completed Drains and Below Ground Services

25.0 NOTICES AND FEES (NOT APPLICABLE)

Allow for giving notice to public and service authorities and for paying all fees and charges legally demandable (except for the supply of water as provided in Clause 15 of the Conditions of Contract), excluding fees for Building Regulations approval.

26.0 INTERIM CERTIFICATES

The Contractor shall apply for Interim Certificates by submitting a Statement of Work executed including the value of materials on site and enclose therewith accounts or invoices in respect of Named Suppliers for work executed.

Receipts for amounts previously certified for Named Sub-Contractors and Suppliers are to be produced for examination as requested.

27.0 DAYWORK

No work shall be allowed to be charged as Daywork unless ordered as such by the Employer in writing. The Employer, or their representative, is to be notified when the work is to be executed and the men employed thereon are not to be employed on other work during its progress. Daywork sheets shall be forwarded to the Employer not later than the week following the period in which the work is executed.

28.0 CLEANING

Cart away all rubbish arising from the works from time to time and/or when directed. No accumulation of debris is to be allowed. No rubbish is to be burned on site.

Allow for twice cleaning of all equipment, floors and any part of the site affected by the installation of the works.

Allow for clearing all drainage free of construction debris.

29.0 PROVISIONAL SUMS FOR NAMED SUPPLIERS

The Provisional Sums for Named Suppliers shall be deemed to **exclude** Contractor's profit and attendance, which should be added.

The Contractor should include for the un-loading and storing of sub contractors materials, returning empties, use of plant and scaffolding and to meet with any special conditions.

30.0 SUB CONTRACTORS

For the purpose of this Contract, all Sub Contractors shall be deemed to be domestic Sub Contractors and the Contractor shall be responsible for their performance in respect of materials used, workmanship and programming to co-ordinate with the rest of the works.

31.0 MATERIALS

All goods and materials used or supplied and all workmanship shall comply with the relevant British Standard Code of Practice.

32.0 BRITISH STANDARDS INSTITUTION (BSI) OR EQUIVILENT DOCUMENTS

Where each year of issue and amendments are not stated, the published versions of BSI Documents (or equivalent) current at the date of Tender will apply.

33.0 SIZES

Unless otherwise stated, products are specified by their co-ordinating sizes.

34.0 MANUFACTURER AND REFERENCE

Where used in this combination

34.1 "Manufacturer" means the firm under whose name the particular product is marketed.

34.2 "Reference" means the proprietary brand name and/or reference by which the particular product is identified.

35.0 MANUFACTURERS RECOMMENDATIONS

Means the manufacturers recommendations or instructions printed or in writing and current at the date of Tender.

36.0 OR OTHER APPROVED

Means that products of different manufacture may be substituted if prior approval has been obtained. The rates of or prices will be held based on the product(s) specified. Any equipment substitutions shall be agreed in writing by the Consulting Engineer prior to placing orders.

37.0 SAMPLES ETC

Samples of materials, i.e. lagging finishes, valves, commissioning sets etc are to be submitted (without charge) to the Employer for approval before use, if and when required. Such samples will be returned to the Contractor if desired carriage forward.

38.0 DEFECTS LIABILITY

Allow for making good any defects, or other faults which may appear within the Defects Liability Period as described in the JCT Contract. The Contractor shall allow for maintaining the works in good repair during this period.

39.0 CONTINGENCIES

Allow a Provisional Sum for Contingencies as detailed on the Tender Form, this amount to be expended as will be directed in writing.

40.0 STANDARD OF WORKMANSHIP AND MATERIALS

In all respects, the Standard of Workmanship must comply with the Standard Specification and all current Codes of Practice in force at the time of tender.

41.0 HEALTH AND SAFETY

The contractor shall comply fully with all Health and Safety requirements under the draft of the Health and Safety legislation 1974, as part of the construction process.

42.0 SCHEDULE OF RATES

When requested and before a tender can be accepted, the Tenderer is to forward, to the Building Services Consultant/Consulting Engineer, a priced and detailed Schedule of Rates, itemised and totalled to agree with the stated Tender Sum. Each service as set out in the Form of Tender shall be priced separately. The rates used in the schedule are to include labour, materials and on cost elements. Should any variations occur during the progress of the works, which cannot be priced from the Schedule of Rates, work is to be priced upon materials and labour basis. The Tendered is to confirm in their Schedule of Rates, current labour rates and the percentage on-costs for labour and materials by completing the Daywork Rates Schedule.

43.0 DEFECTS LIABILITY PERIOD

The defects liability period, including the guarantee for all plant and equipment supplied, is to be twelve months from the date of practical completion. During that period the Contractor is to be responsible for the remedying of any defects when called upon to do so. Should it become necessary for the Contractor to replace or renew a defective portion of the works under this clause, the twelve months liability period for that work is to run from the date of such a replacement or renewal.

44.0 CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS

The Contractor is to co-operate with the Principal Designer in the preparation of all information required in connection with the Construction (Design and Management) Regulations 2015, as and when requested to do so, and to submit their responses for inclusion within the Construction Phase Plan for the whole project.

The successful Contractor shall be deemed to be the "Principal Contractor" under the CDM Regulations 2015.

45.0 REQUIREMENT TO PRODUCE FABRICATION/INSTALLATION DRAWINGS

The Contractor shall co-ordinate the Engineering Services as part of this Contract.

Agree principles with all parties concerned.

Provide all necessary details, drawings, schedules etc to enable co-ordination drawings to be prepared by their own appointed CAD draughtsperson.

Ensure that the installation drawings make due allowance for all building elements, structure and other services.

Prior to submission the Contractor shall check and approve all drawings and schedules and other information provided by manufacturers, nominated suppliers or specialist sub contractors to ensure that all the requirements of the contract documentation have been incorporated.

All documents submitted shall be provided with a certificate indicating that they have been checked by the Contractor.

Drawing information shall be provided in print form and memory stick in CAD format.

The Contractor shall provide schematic drawings, detailed drawings, coordination drawings and fabrication drawings, installation and wiring drawings as necessary.

In addition to the above the Contractor should provide builders work information where required, Sub Contractors Drawings and Manufacturer's drawings shall be included within the proposals, and should be certified drawings.

Control logic diagrams, switchgear starter and control instrumentation and panel drawings, as installed drawings and record drawings. Record drawings will form part of the O & M Manuals and should be provided to form 2 sets of O & M Manuals and a Memory stick set in AutoCAD format.

The Contractor shall also provide plantroom schedules and schematics, as part of a laminated set, which shall be mounted within the plantroom itself (valve schedule).

Generally the Contractor shall provide drawings for construction in form and number as required and shall provide additional copies of drawings as may be reasonably required by the employer.

46.0 OPERATING AND MAINTENANCE (O & M) MANUALS – BY CONTRACTOR

A full set of O & M Manuals will be provided by the Contractor which will include a full set of as installed drawings, for all systems.

The Contractor shall provide maintenance instructions and guarantees and all technical literature associated with the project. Copies of this ledger shall be kept on site and readily accessible for reference by all

supervisory and maintenance personnel. The O & M Manuals shall be presented in a 4 clip ring binder which shall be clearly marked indicating the nature of the contract, the date, the works that took place, and all other details of the project. All drawings shall be separately included in plastic sachets for easy retrieval. These documents shall form part of the Health and Safety File as required by the CDM Regulations 2015.

The Operating and Maintenance Manuals shall be fully integrated with and relate to (including all necessary cross referencing) the original building O&Ms.

2.0 SCOPE OF WORK

It is intended that this specification should be read in conjunction with the Standard Technical Specifications for the Mechanical and Electrical Services and the contract drawings.

These works include the supply, installation and testing of the works, making good any defects that occur during the defects liability period and the provision of documents which include "as fitted drawings" together with operating and maintenance manuals.

Upon the award of tender the Contractor shall submit within 7 days, to the Engineer a schedule of dates for the start, changeover and handover of the completed project.

These works include comprehensive planned maintenance on all installed plant items for a period of twelve months following acceptance of the completed installation.

The existing heating, ventilation and cooling plant within the building is approximately 25 years old. Some of the plant items have been replaced in this time, notably the chillers, but essentially the installation is the same as installed back in 1997.

This Phase 1 project will see the following plant items replaced/modified to improve the operation and energy efficiency of the building:

- New Condensing Boilers
- New variable speed pumps for heating and cooling circuits
- New Pressurisation Units for heating and cooling circuits
- Revised Ventilation System
- 2 Port Valve Control
- New Dehumidifiers to assist with controlling environmental conditions
- New Building Management System

As well as the above works, the existing ventilation, heating, cooling and environmental systems will be recommissioned with new settings to further improve energy efficiency.

Specific products have been specified within this document. Bidders may put forward equivalent products, however, where a bidder chooses to do so then they must ensure that on technical details, the equivalent produce is like for like, both in performance and quality. Any substitutions must be submitted in writing for approval prior to ordering.

Additional improvements may be planned for Phase 2 works at a later date to further enhance the system operation and improve energy efficiency. This will be incorporated into potential future building remodelling.

2.0.1 BUILDERS WORK

The Contractor shall carry out all minor Builders work. These works include :-

- Forming concrete boiler plinths
- Forming holes for pipes and cables
- Forming holes for ductwork

All builders work shall be carried out in a professional manner with all works being undertaken to a high standard.

Once the new boiler plinths are installed the boiler room floor and plant plinths shall be painted with a quality red flooring paint to seal the floor. The walls in the vicinity of the new boilers and pipework shall be painted with a white emulsion paint to tidy the existing room.

All holes and openings in the building/structure shall be formed using appropriate methods. Any holes in fire compartments shall be treated with a fire resistant sealant/filler to ensure compartmentation is maintained.

2.1 NEW CONDENSING BOILERS AND ANCILLARY EQUIPMENT

The existing Clyde combustions 224-E-45, gas boilers are the original item installed in 1997. These boilers are each rated at 45kW providing a maximum demand of 90kW to the building. The existing building's heating load is approximately 78kW. The existing boilers are believed to be approximately 55% efficient.

The existing boilers are atmospheric units and shall be replaced with more efficient condensing boilers.

The new boilers shall be Hamworthy Stratton boilers (or equivalent to match technical specification). 2 boilers shall be fitted to a manufacturers frame kit to provide 90kW of heating output.

The new boilers shall have a seasonal efficiency of 95.75% (Gross).

The Contractor shall remove the existing boilers and local flue connections. The existing concrete plinth shall be modified to suit the new frame mounted boiler array. The existing plinth shall be extended along the southern wall to provide a suitable footing for the frame.

2 New boilers shall be installed on the manufacturers supplied frame and pipework kit. The boilers shall be installed in accordance with the manufacturers instructions. The boiler array shall be fitted with the matching Hamworthy Heating isolation plate heat exchanger.

The new boilers, frame, pipework, shunt pumps and heat exchanger shall be as follows items (or equivalent to match technical specification):

Boiler : Stratton mk3 40kW Stainless Steel Wall Hung Condensing Boiler (AA082635)	2
Header kit : Frame and Header Kit DN50 2 wide (232860)	1
Gas Header : Gas Header (Included within DN50 F&H kit)	
Separation : DN50 150KW Plate Heat Exchanger Kit (232890)	1

Pump : UPMXXL Pump Kit (232884)	2

The new boilers shall be fitted with a new flue connection header which shall connect to the existing flue riser by means of a proprietary adaptor collar.

The new boilers shall be connected to the existing heating flow and return connections via the specified separation heat exchanger. This shall be fitted to prevent heating system debris fouling the new boilers and prolonging their life.

The new boilers are condensing models and as such they shall have drainage connections from the boilers and flue. This drainage pipework shall be run to the existing floor drain.

The new boilers shall be initiated by the new Building Management System (BMS) with local control, sequencing, shunt pump operation carried out by the boilers integral controller. New local electrical supplies for each boiler shall be installed using the existing services and adapted containment.

A dirt and air separator (DAS1) shall be fitted to assist in maintaining system cleanliness and the removal of air. Separator to be Fabricated Products Cleanvent SCVAD 40mm (or equivalent to match technical specification).

A 3.5 litre dosing pot (DP1) shall be installed in the primary pipework to protect the boiler array and associated pipework. This dosing pot shall be a Fabricated Products SSDP3.5.

Isolation valves, automatic air vents, drain cocks, sensor pockets shall be installed as per the proposed schematic and layout drawing.

All pipework shall be fully insulated with foil faced mineral wool and proprietary valve/fitting muffs. Refer to insulation section.

The existing gas supply pipe shall be modified to suit the new boiler array. The existing freefall drop valve, wire, pulley's and fusible links shall be removed.

The existing gas solenoid valve shall be retained as the fire control valve. New electro thermal links shall be installed over each boiler to provide signal of boiler fire.

2.2 NEW VARIABLE SPEED PUMPS FOR HEATING & COOLING CIRCUITS

The existing cooling pumps are believed to be the original items installed in 1997 albeit with replacement motors. The heating pumps have been replaced in the past couple of years. These types of pumps are fixed speed units. The pumps are set on a preset speed at the time of commissioning and then left to run at those speeds when called for. This means that the pumps will run at their maximum set speed even if only part of the system requires flow.

A new pair of variable speed pumps shall be installed on the heating and cooling circuits to accurately meet the respective circuits demand.

2.2.1 HEATING PUMPS

The existing heating pumps shall be replaced with new items. The existing KSB (Smedeguard) Etaline Z 05060-160 pumps are a recent replacement for the originally specified Grundfos UPSD50-120F

The new pumps P1/P2 shall be Grundfos Magna 3 50-120F (or equivalent to match technical specification).

They shall be set to operate at the design flow of 1.96l/sec. The pumps shall run as duty/standby as dictated by the BMS.

The pumps shall run on constant pressure setting to maintain a static pressure across the system. Pump speed shall increase/decrease to maintain the optimum pressure at the required flow set point.

New rubber anti vibration bellows shall be installed to the pump.

A preformed insulation shell shall be provided to maintain heating efficiency across the pump body.

New wiring back to a local isolator shall be provided. Wiring to be flexible cables run within a glanded Kopex outer conduit.

2.2.2 COOLING PUMPS

The existing cooling pumps are largely the original items installed in 1997. The pump motors have been replaced over the years. The existing pumps are Grundfos LPD65-125/142.

The existing pumps shall be replaced with new Grundfos TP3D 65-180 (or equivalent to match technical specification). Pumps shall be set to operate as duty/standby as dictated by the BMS.

They shall be set to operate at the design flow of 3.59 l/sec.

The pumps shall run on constant pressure setting to maintain a static pressure across the system. Pump speed shall increase/decrease to maintain the optimum pressure at the required flow set point.

New rubber anti vibration bellows shall be installed to the pump.

A preformed insulation shell shall be provided to maintain cooling efficiency across the pump body.

New wiring back to a local isolator shall be provided. Wiring to be flexible cables run within a glanded Kopex outer conduit.

2.3 NEW PRESSURISATION UNITS FOR HEATING AND COOLING CIRCUITS

The existing pressurisation unit is a Hamworthy Heating HPS dual circuit pump set. This pump unit maintained the system pressures within the heating and cooling circuits.

The pressurisation unit is the original item installed in 1997.

The unit is at the end of its economic life and should be replaced to maintain system effectiveness.

2 new pressurisation units shall be installed (one for each circuit).

The new units shall be Mikrofill 3 compact units (or equivalent to match technical specification) .

PU1 shall serve the heating circuit

PU2 shall serve the cooling circuit

They shall be wall mounted in the position if the existing unit. Each unit shall be piped to their existing respective expansion vessels (Heating 100 litre/ Cooling 60 litre) and the system lockshield valve with new copper pipework.

The pressurisation units shall operate independently by means of programmed set points. High and low pressure alarm signals shall be run to the BMS to raise a central alarm.

Each pressurisation unit shall have a 15mm (1/2") pulsed water meter fitted to record any system fill water. The units shall be set to record 1 pulse per litre of water.

2.4 REVISED VENTILATION SYSTEM

The existing ventilation system is the heart of the building providing fresh air, heating, cooling and humidity for the building.

The system is largely the same as installed in 1997. Since the opening of the building the systems have generally worked well maintaining the important environmental conditions.

Over the years the system has been maintained by various contractors and the system is still working satisfactorily.

However, in recent years with increased energy costs the effectiveness of the system and its operation requires re-thinking and modification to adapt it to suit.

The ventilation system shall be modified as follows:

2.4.1 PAINTING & ARCHIVE STORE VENTILATION

Supply Fan 3, Extract Fan 3 (AHU3) serving the Painting and Archive stores shall be removed. The existing supply and extract fan units shall be dismantled and removed from site.

This shall include the inertia base frame, drip trays along with heating and cooling pipework back to their point of isolation.

A new supply fan unit shall be installed on a Unistrut frame at high level in the space to provide additional storage space below.

The Unistrut frame shall be topped with a galvanised steel drip tray sized to suit the installation of the new supply fan unit. The drip tray shall sit below the new supply fan unit and shall span its length to provide protection for any goods/artifacts etc stored on racking below.

The new fan unit shall be a Nu Aire Boxer Unit with integral heating and cooling coil. Model ref ESBH2-2-LC (or equivalent to match technical specification).

Fan duty to be 0.5m3/sec @ 150Pa.

19kw LPHW Coil (82°C/71°C)

27kW Cooling Coil (7°C/12°C)

Heating & cooling coils to be supplied complete with matched 2-port control valves for operation by the BMS.

All control and power cabling to be run in containment with local isolators where required.

The new fan unit shall operate with a Mechanical Ventilation Heat Recovery (MVHR) fan unit.

This new MVHR unit (HRF1) shall be a Blauberg Komfort EC LBE700(-E) S21 (or equivalent to match technical specification).

This fan unit shall be wall mounted sitting below the existing plantroom roof vent dormers. The MVHR fan unit shall draw in fresh air from outside and mix it with the ambient air from the painting store/unloading bay. The useful heat from inside shall be transferred to the fresh air by means of the integral heat exchanger. This warmed fresh air shall then pass to AHU 3 for further heating/cooling treatment.

Fan unit HRF1 shall be controlled via the BMS through the S21 controller.

Both AHU3 and HRF1 shall have new ductwork to allow connection to the existing terminals and duct systems. New ductwork shall be galvanised steel to DW142. All ductwork shall be made up of flanged sectional items allowing disassembly. Ductwork to be fully supported along the run using drop rod hangers and Unistrut rails.

Access panels to be provided prior to connections to fan units to allow inspection.

All ductwork shall be insulated with foil faced mineral wool slabs. Insulation to have taped seams to seal. Flow arrows to be applied.

2.4.2 AIR HANDLING UNITS AHU1 & AHU2 MODIFICATIONS

The existing air handling units within the roof top plant room supply and exhaust air from the main gallery spaces. At present the approximately 2/3rds of the exhaust air is recirculated back into the fresh air stream to serve the gallery spaces.

By introducing fresh air in a fixed quantity, the AHU's are having to heat and condition the air which can be costly. When the building is closed or partially occupied it requires less fresh air than when it is full.

The proposal is to allow the air quantities to be adjusted to suit the building open status and occupancy levels.

As such the existing air intake, exhaust and mixing dampers shall be fitted with motorised actuators to allow automated adjustment of air flows and volumes to suit the environmental conditions and visitor numbers.

Fan speeds will also be adjusted based upon occupancy by measuring the Carbon Dioxide (CO2) levels within the extract air streams.

The contractor shall remove the existing manual intake and exhaust dampers from AHU1. These 300x200mm dampers shall be replaced with new multileaf dampers with extended spindles to allow the fitment of actuators.

The intake, exhaust and mixing dampers on AHU2 shall be replaced with new 300x200mm multileaf dampers with extended spindles to allow the fitment of actuators.

The Contractor shall supply and fit Belimo LM230A-S damper actuators to the intake, mixing and exhaust dampers (or equivalent to match technical specification). Control cabling shall be run back to the BMS control panel/outstation for connection by BMS Contractor.

2.5 2 PORT VALVE CONTROL

The existing heating and cooling coils on the AHU's are controlled by 3 port valves. These valves allow continuous flow around their respective circuit diverting flow when required to heat or cool as appropriate.

This method of operation was typical of the installations when the system was designed. With newer controls and energy efficient variable speed pumps the system can be adapted to 2 port valve operation.

This method only allows flow through the system when it is required. As such the primary heating and cooling pumps can vary their speed and in turn flow rate to meet the actual demand.

The Contractor shall modify the existing pipe circuit by isolating the double regulating valve (DRV) on the centre port, isolating the flow.

The Contractor shall supply and fit pressure switches to the heating and cooling index runs. These locations shall be as per the tender drawings.

Pressure switches shall be supplied free issue by the BMS Contractor. Switches to be fixed into a ½" threaded brass bush.

The controls shall be modified to allow control via system pressure by the BMS Contractor.

2.6 NEW DEHUMIDIFIERS TO ASSIST WITH CONTROLLING ENVIRONMENTAL CONDITIONS

The museum's environmental conditions are controlled to provide a steady level of temperature and humidity to maintain the correct conditions to preserve the art works, prints, photographs, exhibits etc.

These conditions are set out by central government to obtain lending museum status.

The existing environmental parameters are 19-25°C and 45-55% relative humidity.

Being on the coast Penzance is susceptible to large fluctuations in temperature and humidity.

Temperature is adjusted by heating or cooling the incoming air. Humidity is adjusted by cooling the air to drop the moisture out and then reheating it to the required temperature. Additional humidity can be introduced into the air streams by means of a steam humidifier which sprays moisture into the incoming air flow.

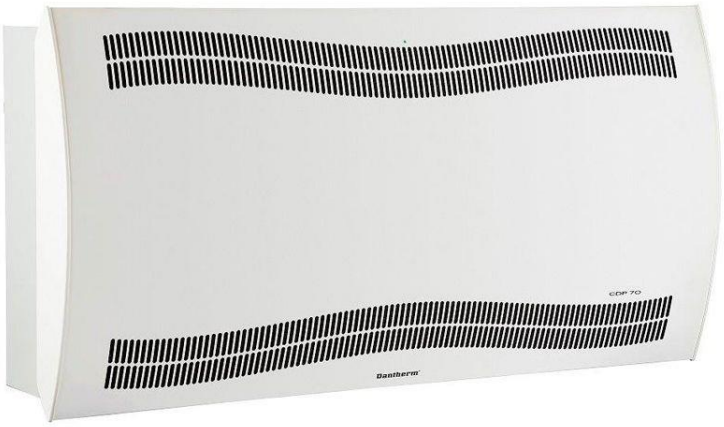
Cooling air is an energy hungry process and cooling the air to reduce humidity even more so. This due to the fact that the airflow requires cooling to drop the moisture out and then re-heating to bring it back up to temperature.

In order to reduce the chiller demand the proposal is to install local dehumidifiers in the gallery & storage areas to treat the air. These local dehumidifiers will reduce the need to operate the main chillers as they cool the air and use their normal waste heat to reheat it in one operation.

The Contractor shall supply and fit new dehumidifiers to serve the gallery and plant spaces.

These dehumidifiers shall be Dantherm CDP units (or equivalent to match technical specification) suited to museums & galleries. Working with the gallery staff the dehumidifiers shall be wall mounted in suitable locations as shown on the drawings.

Each gallery shall be fitted with a wall unit. The Painting & Artifact stores shall each have a unit fitted.



Dantherm CDP Dehumidifier Unit (or equivalent to match technical specification)

Unit References:

- Gallery 1 (Dehumidifier 1) Dantherm CDP 70
- GF Hallway (Dehumidifier 2) Dantherm CDP 70
- Gallery 3 (Dehumidifier 3) Dantherm CDP 70
- Painting Store (Dehumidifier 4) Dantherm CDP 70
- Landing (Dehumidifier 5) Dantherm CDP 70
- Gallery 5 (Dehumidifier 6) Dantherm CDP 70
- Artefacts Store (Dehumidifier 7) Dantherm CDP 70

Unit references and fascia finish shall be confirmed by the Engineer prior to placing orders. Dehumidifiers shall be white cased finish. Fused connection units, conduit/trunking to be white to match the building's décor. Where building décor differs conduit/trunking shall be painted to blend in with décor.

The unit shall be wall mounted using secure fixings. Supplementary fixings or supports may be required to reinforce the wall substrate. If this is deemed necessary, the contractor shall ensure that any additional support is discrete and in keeping with the building. The Contractor shall install a switched fused spur adjacent to the unit for local power supply. The units shall be wired back to the BMS for centralised control and monitoring.

The unit shall be fitted with a gravity drain to discharge to a suitable foul/RWP. Exposed drain hoses shall not be accepted and the Contractor shall allow for neatly running the hose within decorative containment to a suitable drain point.

It has been assessed that all units should be able to drain via gravity to the basement to discharge into the existing sump pump pit for onward pumping to outside. All drains shall fall at a steady constant gradient. Main drain runs within the basement shall be via 32mm PVC waste pipe secured to the structure. Rodding eyes and tundisishes shall be installed to allow the system to be inspected, cleaned and vented to atmosphere.

BMS interface shall be made via a Modbus RTU (RS-485) wired connection.

Each unit shall be set to control the humidity to 50-55%RH. A fault of the unit shall raise a BMS alarm.

2.7 NEW BUILDING MANAGEMENT SYSTEM

The existing Building Management System (BMS) shall be upgraded with new system components to improve user interface, energy efficiency, reliability, and future expansion.

The existing BMS installation is based upon a Trend IQ241 controller. This controller is the existing unit installed in 1997. Although function support has been discontinued for this particular product range which has now been superseded by newer models.

As part of the project the system will be upgraded with a new controller, sensors and relevant control devices.

The system will be upgraded to a Schneider Eco Struxure Controller (Smart X) - (or equivalent to match technical specification). The existing wiring and infrastructure will largely stay the same with minor alterations where necessary to support the new boilers, pumps and ventilation equipment.

The existing control panel fascia will be replaced to enable installation of a touchscreen controller enabling the Client to modify settings, check control features and system alarms. These features shall also be available on the buildings computer network allowing staff to log in from the office or remotely.

Temperature & Humidity logs shall be stored within the BMS for 12 months to allow the museum to upload, print and record environmental trends.

The system shall be as per the quotation issued by Schneider Electric OP-240111-13901988 (6th March 2024) - (or equivalent to match technical specification).

The BMS installation shall be installed in a neat and tidy manner. Any new sensors in public/gallery areas shall be sympathetically installed.

The system shall operate as per the Controls Methodology below.

CONTROL METHODOLOGY (FOR INFORMATION)

This description of operation should be used in conjunction with the control panel diagrams, the specification and schematic diagram.

2.7.1 AIR HANDLING UNIT - AHU1

This AHU provides independently controlled supplies to:

(A) Galleries G2, G3 and G4

(B) Gallery 5

Its supply (SF1) and extract (EF1) fans both have Hand/Off/Auto switches at the control panel. In "auto" mode, an adjustable time zone shall determine when the fans operate, the extract fan being interlocked with the supply fan.

Both fans have speed controller frequency inverters which once enabled operate as follows:

A) Frequency inverter (FI1) shall modulate the speed of Supply Fan (SF1) to overcome pressure drops within the system (ie filter blockage) by maintaining the static pressure at the fan discharge prior to the duct splitting, as sensed by sensor P1

Frequency inverter (F11) shall modulate the supply fan speed dependent upon measured CO^2 levels within the extract duct. Levels of 800ppm (adjustable) or below shall operate the fan at low speed/stop. Levels measured at 1000ppm (adjustable) shall operate the fan at normal speed and levels of 1500ppm (adjustable) shall increase the fan speed to maximum.

B) Frequency inverter (FI2) is provided to enable the speed of the Extract fan (EF2) to be adjusted for balancing during commissioning. Once set-up, the fan will take up its pre-determined speed - there is no automatic speed control.

Frequency inverter (F12) shall modulate the extract fan speed dependent upon measured CO^2 levels within the extract duct. Levels of 800ppm (adjustable) or below shall operate the fan at low speed/stop. Levels measured at 1000ppm (adjustable) shall operate the fan at normal speed and levels of 1500ppm (adjustable) shall increase the fan speed to maximum.

The flow status of both supply and extract fans is monitored by air differential pressure switches (DP3 and DP4 @ 150Pa resp) and accordingly reported to the BMS. Similarly, both frequency inverters are monitored for faults and reported to the BMS. Both these alarms are annunciated at the panel.

Should 'hand' be selected at the BMS panel, then the respective fan takes up a pre-determined speed (in respect of the Extract Fan, this is the same speed as detailed above).

Upon receipt of a fire alarm, both the supply and the extract fans would stop. This condition could be overridden at the Fireman's Ventilation Switch in the staff entrance area by selecting "Vent On". Switch position to be located adjacent to fire alarm panel.

An electric frost coil, (Coil 1) shall be enabled if the temperature coming into the AHU fan section falls below 5°C, as detected by dual frost thermostat (t1). Should the temperature at t1 continue to fall to 1°C, indicating a frost coil failure, the supply and extract fans shall be switched off and an alarm given to the BMS.

Panel and bag filter conditions shall be monitored by air differential pressure switches (DP1 and DP2 resp) and when 'dirty', (100 and 275Pa resp) will raise an alarm at the BMS and annunciate same at the control panel.

Supply system A, (serving Galleries G2, G3 and G4) shall have its temperature adjusted by sequential control of heating (MV13) and cooling (MV14) valves as required to satisfy the return air temperature sensor (T2) as extracted from landing, first floor at 19.5°C. Should the supply air temperature (T3) fall below 10°C or go above 35°C, the BMS shall shut down the AHU and raise an appropriate alarm.

The space temperature (T18) and humidity (H9) within Gallery G2/3 shall be monitored for data logging, one reading every hour.

Supply System B, (serving Gallery G5) shall have its temperature adjusted by sequential control of heating (MV8) and cooling (MV7) valves as required to satisfy the return air temperature sensor (T1) at 19.5°C. Should the return air relative humidity (H1) go above 50% (adjustable) the cooling valve (MV7) shall modulate in attempt to de-humidify and the heating valve (MV8) opened to re-heat in compensation. Should the supply air temperature (T4) fall below 12°C or go above 30°C, the BMS shall shut down the AHU and raise an appropriate alarm. Should the supply air RH% (H2) fall below 35% or go above 65% an alarm is sent to the BMS.

Duct temperature sensor (T5) monitors the off-cooling coil temperature, (this is to be protected from the radiant effect of the heating coil).

Gallery G5 and Landing are served by three fan coil units (FCU/02, /03 and /04), each with Hand/Off/Auto switches at the control panel. In "auto" they are enabled together under the same time zone as AHU1.

The FCU heating valves (MV02, 03 & 04) are modulated in unison to satisfy the return air temperature (T16) from Landing at 20°C.

Panel filter condition is monitored for each FCU by air differential pressure switches (DP13, 14 and 15 respectively) and when. 'dirty' (at 100Pa) will raise an alarm at the BMS and annunciate same at the control panel. Run and trip conditions of each FCU are also annunciated on the panel.

Under fire a condition the FCU's would stop. This condition is overridden when "Vent On" is selected at the Firemans Ventilation Switch.

The space temperature (T19) and humidity (H10) within the Local History Gallery shall be monitored for data logging, one reading every hour.

2.7.2 AHU2

This AHU provides controlled ventilation to Gallery G1

Its supply (SF2) and extract (EF2) fans both have Hand/Off/Auto switches at the control panel. In "auto" mode, an adjustable time zone shall determine when the fans operate, the extract fan being interlocked with the supply fan.

Both fans have speed controller frequency inverters which once enabled operate as follows:

A) Frequency inverter (FI3) shall modulate the speed of Supply Fan (SF2) to overcome pressure drops within the system (ie filter blockage) by maintaining the static pressure at the fan discharge as sensed by sensor P2

Frequency inverter (F13) shall modulate the supply fan speed dependent upon measured CO^2 levels within the extract duct. Levels of 800ppm (adjustable) or below shall operate the fan at low

speed/stop. Levels measured at 1000ppm (adjustable) shall operate the fan at normal speed and levels of 1500ppm (adjustable) shall increase the fan speed to maximum.

B) Frequency inverter (FI4) is provided to enable the speed of the Extract fan

(EF2) to be adjusted for balancing during commissioning. Once set-up, the fan will take up its pre-determined speed - there is no automatic speed control.

Frequency inverter (F14) shall modulate the extract fan speed dependent upon measured CO^2 levels within the extract duct. Levels of 800ppm (adjustable) or below shall operate the fan at low speed/stop. Levels measured at 1000ppm (adjustable) shall operate the fan at normal speed and levels of 1500ppm (adjustable) shall increase the fan speed to maximum.

The flow status of both supply and extract fans is monitored by air differential pressure switches (DP7 and DP8 @ 150Pa resp) and accordingly reported to the BMS. Similarly, both frequency inverters are monitored for faults and reported to the BMS. Both these alarms are annunciated at the panel.

Should 'hand' be selected at the panel, then the respective fan takes up a pre-determined speed (in respect of the Extract Fan, this is the same speed as detailed above).

Upon receipt of a fire alarm, both the supply and the extract fans would stop. This condition could be overridden at the Firemans Ventilation Switch in the reception area by selecting "Vent On".

An electric frost coil, (Coil 2) shall be enabled if the temperature coming into the AHU fan section falls below 5°C, as detected by dual frost thermostat (t2). Should the temperature at t2 continue to fall to 1°C, indicating a frost coil failure, the supply and extract fans shall be switched off and an alarm given to the BMS.

Panel and bag filter conditions shall be monitored by air differential pressure switches

(DP5 and DP6 resp) and when 'dirty', (100 and 275Pa resp) will raise an alarm at the BMS and annunciate same at the control panel.

The supply serving Gallery G1 shall have its temperature adjusted by sequential control of heating (MV5) and cooling (MV6) valves as required to satisfy the return air temperature sensor (T6) at 19.5°C. The supply humidity shall be controlled by sequential control of the cooling valve (MV6) to de-humidify and the operation (0-10V) of the humidifier (HUM1) as required to satisfy the return air relative humidity sensor (H3) at 50%. During de-humidification the heating valve (MV5) opens to re-heat as required. Should the supply air temperature (T7) fall below 12°C or go above 30°C, the BMS shall shut down the AHU and raise an appropriate alarm. Should the supply air RH% (H4) fall below 35% or go above 65% an alarm is sent to the BMS, this sensor also reduces the signal to HUM1 when humidity exceeds 75% and shuts down HUM1 if RH% exceeds 85%.

Duct temperature sensor (T8) monitors the off-cooling coil temperature, (this is to be protected from the radiant effect of the heating coil).

2.7.3 AHU3

This AHU provides independently controlled supplies to:

A) The Artefacts Store

B) The Painting Store and Unloading Bay

Its supply (SF3) fan shall have Hand/Off/Auto switches at the control panel. In "auto" mode, an adjustable time zone shall determine when the fans operate, the extract fan being interlocked with the supply fan.

The fan shall have speed controller frequency inverters which once enabled operate as follows:

A) Frequency inverter (FI5) shall modulate the speed of Supply Fan (SF3) to overcome pressure drops within the system (ie filter blockage) by maintaining the static pressure at the fan discharge prior to the duct splitting, as sensed by sensor P3

Frequency inverter (F15) shall modulate the supply fan speed dependent upon measured CO^2 levels within the extract duct. Levels of 800ppm (adjustable) or below shall operate the fan at low speed/stop. Levels measured at 1000ppm (adjustable) shall operate the fan at normal speed and levels of 1500ppm (adjustable) shall increase the fan speed to maximum.

The flow status of the fan is monitored by air differential pressure switches (DP10 @ 150Pa and accordingly reported to the BMS.

The frequency inverter is monitored for faults and reported to the BMS.

This alarm is annunciated at the panel.

Should 'hand' be selected at the panel, then the fan takes up a pre-determined speed.

Upon receipt of a fire alarm, both the supply fan would stop. This condition could be overridden at the Firemans Ventilation Switch in the reception area by selecting "Vent On".

An electric frost coil, (Coil 3) shall be enabled if the temperature coming into the AHU fan section falls below 5°C, as detected by dual frost thermostat (t3). Should the temperature at t3 continue to fall to 1°C, indicating a frost coil failure, the supply and extract fans shall be switched off and an alarm given to the BMS.

The Panel filter condition shall be monitored by air differential pressure switch (DP9) and when 'dirty', (100Pa) will raise an alarm at the BMS and annunciate same at the control panel.

Supply air system, (serving The Painting & Artefacts Store) shall have its temperature adjusted by sequential control of heating (MV9) and cooling (MV10) valves as required to satisfy the return air temperature sensor (T9) as extracted from the Artefacts Store at 19.5°C.

Should the supply air temperature (T11) fall below 12°C or go above 30°C, the BMS shall shut down the AHU and raise an appropriate alarm. Should the return air relative humidity (H5) go above 60% (adjustable) the cooling valve (MV10) shall modulate in attempt to de-humidify and the heating valve (MV9) opened to re-heat as required.

Should the supply air RH% (H7) fall below 35% or go above 65% an alarm is sent to the BMS.

Duct temperature sensor (T13) monitors the off-cooling coil temperature, (this is to be protected from the radiant effects of the heating coil).

2.7.4 HEAT RECOVERY FAN (HRF) 1

Heat recovery fan unit 1 (HRF1) shall work in conjunction with AHU3 to provide fresh tempered air to the painting store allowing AHU3 to utilise this air for onward treatment & distribution to the other store areas.

HRF1 shall be self controlling via its supplied interface panel. HRF1 shall start and stop via a signal from the BMS. On/Off/Auto switches on the BMS shall allow manual control.

The unit shall run at the required fan speed when called for by the BMS.

If HRF1 raises a fault alarm it shall be relayed to the BMS via the internal BACNet communication.

Upon receipt of a fire alarm, HRF1 would stop. This condition could be overridden at the Firemans Ventilation Switch in the reception area by selecting "Vent On".

2.7.5 FAN COIL UNIT FCU/01

This Fan Coil Unit provides controlled ventilation to the Shop/Cafe.

Its supply fan and associated extract fans (EF5&6) each have Hand/Off/Auto switches at the control panel. In "auto" mode, an adjustable time zone shall determine when these fans operate, extract fans EF5 and EF6 being interlocked with the FCU.

A trip condition of either motor is monitored and annunciated at the panel.

Upon receipt of a fire alarm, all fans would stop. This condition could be overridden at the firemans Ventilation Switch in the reception area by selecting "Vent On".

An electric frost coil, (coil 4) shall be enabled if the temperature coming into the FCU falls below 5°C, as detected by dual frost thermostat (t4), Should the temperature at t4 continue to fall to 1°C, indicating frost coil failure, the FCU shall be switched off and an alarm given to the BMS.

The panel filter condition shall be monitored by air differential pressure switch (DP12) and when 'dirty', (100Pa) will raise an alarm at the BMS and annunciate same at the control panel.

The supply system to the Cafe shall have its temperature adjusted by the control of the heating valve (MV01) as required to satisfy the supply air temperature sensor (T15 at

20°C).

The space temperature (T24) within the Café shall be monitored for data logging, one reading every hour.

2.7.6 FIRE ROLLER SHUTTER INTERLOCKS

The status of the fire roller shutter shall be monitored by the BMS. In its normal position (ie open), FCU/01 and extract fan EF5 are controlled as described above, EF5 running at full speed.

Should the fire shutter close, then FCU/01 is stopped and EF5 is switched to low speed.

Extract fan EF6 is unaffected by the Roller Shutter Status,

2.7.7 TOILETS EXTRACT FAN (EF4)

This fan extracts air from both the Male and Female Toilets and has an On/Off switch at the control panel. On fire the fan stops but can be overridden from the firemans switch.

Its trip condition is monitored and annunciated at the panel.

2.7.8 BASEMENT RADON EXTRACT FAN (EF7)

This fan has an On/Off switch at the control panel.

The flow status of this fan is monitored by air differential pressure switch (DP16 @ 25Pa) and accordingly reported the BMS. Its trip condition is monitored and annunciated at the panel.

This fan stops on a fire condition but can be overridden from the firemans switch.

2.7.9 LIFT ROOM EXTRACT FAN (EF8)

This fan is not controlled or fed from the control panel. It is to be arranged to run when the thermostat (t5) switches at 27°C.

2.7.10 HEATING SYSTEM

Two boilers provides LTHW to the following systems:-

- Heating Coils (5Nos) within AHU's
- Heating Coils within each FCU (4Nos).
- The underfloor heating circuit

Both boilers have Hand/Off/Auto switches at the control panel. The following interlocks will prevent the boilers operating:-

- Boiler Lock-Out (R20; R22 respectively).
- Fire Alarm (FR)
- Fireguard/gas valve failure/closure (GV)
- Thermal fusible links failure (either of two)
- Neither of heating pumps operational
- Flow failure through boilers, monitored by differential pressure switch FS1
- Heating Pressurisation fault. (R24)

In hand' mode, once all interlocks are satisfied, the respective boiler is enabled.

In 'auto' mode, assuming the interlocks are satisfied, the boilers operate to a heating demand signal identified by the opening of any of the heating valves; MV1,2,3,4,5,8,10,12 or 13 or when the underfloor heating system is running.

Assuming all interlocks are made and both boiler and both pump switches are in 'auto' the following sequence of operation occurs upon receipt of a heating demand as detailed above.

1. The lead heating pump shall run generating flow through the system as identified by the differential pressure switch FS1 located across the pump set.
2. The lead boiler shall then be enabled to operate under the dictate of its own control and high-limit thermostats.

The lead boiler shall fire to operate at 20% load. The second boiler shall also fire to operate at 20% load. Both boilers shall run in unison mode gradually increasing output until the temperature measured at T21 is satisfied at 82°C

A suitable software hysteresis shall prevent frequent boiler hunting.

The boiler flow temperature is monitored by sensor T20.

Boiler lead/lag selection shall be changed every 24 hours of operation or upon lead lock-out. Boiler 'lock-out' is monitored by the BMS and annunciated at the panel. A reset button on the panel requires pressing after a lock-out condition is cleared. Boiler 'Supply On' is also annunciated at the panel.

Boiler shunt pumps shall be controlled by the boilers integral controller.

Heating pump lead/lag selection shall be changed every 24 hours of operation or upon flow failure monitored by FS1. Run and trip indication is shown at the panel.

The heating pump shall operate on Constant pressure mode to achieve the design flowrate. This flow rate shall be measured during commissioning along with the system pressure with all heating circuits calling i.e valves open. This system pressure shall set the maximum demand flow and pressure characteristics. When the system pressure increases as control valves close the pump shall proportionately reduce speed and reduce flow to meet a lower demand.

New pressurisation units shall be installed to individually serve the heating and chilled circuits.

They are operated by local control and shall automatically top up the system pressure as required. Each pressurisation unit shall have high and low alarm and status signals that shall be linked to the BMS panel.

The BMS shall monitor the pulse (1 pulse = 0.5 litre) of a flow meter to measure water

usage to both Heating and Chilled water systems. An alarm is raised should the water lost exceed 2 litres per week.

The underfloor heating system is operated by a Hand/Off/Auto switch. In 'auto' mode the system is activated when the outside air temperature drops below 14°C. Once enabled the system operates under the dictate of its integral control system and direct acting safety valve, all supplied by others.

Electric heating in the offices is provided by electric panel radiators. A remote contactor ECH1 is operated by a Hand/Off/Auto switch at the panel. In 'auto' mode, the contactor is enabled during a pre-determined time zone.

The sump pump has an Off/On switch at the panel. When 'On' the pump operates to the requirements of its integral float switch.

2.7.11 Chilled Water Systems

One chiller provides Chilled Water to the Cooling coils (5nos) within the AHU's.

The chiller has a Hand/Off/Auto switch at the panel. The following interlocks prevents its operation.

- Chilled Water Pressurisation Fault (R24A)
- A chiller fault (R26)
- Neither of the Chilled Water pumps operational
- Flow failure through Chiller.

In 'hand' mode, once all interlocks are satisfied, the chiller is enabled.

In 'auto' mode, assuming the interlocks are satisfied, the boilers operate to a cooling demand signal identified by the opening of any of the cooling valves; MV6, 7, 9, 11 or 14, as follows:-

1. Upon the cooling demand (ie first Ch.W valve open), the lead Chilled Water pump shall run, generating flow through the system as identified by the differential pressure switch FS2 located across the pump set.

2. The chiller is then enabled to operate under the dictate of its own integral control circuitry.

The cooling pump shall operate on Constant pressure mode to achieve the design flowrate. This flow rate shall be measured during commissioning along with the system pressure with all CHW circuits calling i.e valves open. This system pressure shall set the maximum demand flow and pressure characteristics. When the system pressure increases as control valves close the pump shall proportionately reduce speed and reduce flow to meet a lower demand.

A Chiller fault status is monitored by the BMS and annunciated at the panel. A reset button on the panel requires pressing after the fault is cleared.

An ammeter and voltmeter on the panel shall register respective loading on the supply to the chiller, the signals for these meters are derived from metering supplied by the mechanical contractor with a 4-20mA output.

Chilled water pump lead/lag selection shall be changed every 24 hours of operation or upon flow failure monitored by FS2. Run and trip indication is shown at the panel.

The chilled water flow and return temperatures are monitored by sensors T22 and T23 respectively.

The chiller has a Crankcase heater which is operated by integral controls.

2.7.12 FROST PROTECTION CONTROLS

Should the outside temperature (T17) fall below 5°C the lead Heating Pump and the lead Chilled Water pump shall run to avoid risk of freezing points.

Should the temperature of any immersion sensor fall below 2°C, the Boilers shall be energised to control at a reduced return temperature of 40°C.

The chilled water pipework is trace heated. Assuming the panel switch is in 'Auto' the trace heating is brought on if the flow temperature monitored by T22 drops below 2°C.

2.7.13 GALLERY DEHUMIDIFICATION

The galleries and painting and archive stores shall have local wall mounted dehumidifiers fitted. These shall be fitted to reduce the requirement for traditional CHW/LPHW humidification.

The units shall operate to a set point of 50%RH (adjustable). The units shall run as dictated by their integral controls based upon the setpoint.

The units shall control the humidity in the spaces during normal operation. If the humidity rises above 55%RH then the chiller circuit shall be called to operate.

This shall then revert to traditional dehumidification as described above for the relevant AHU. In the event of a dehumidifier failure or dehumidifier service the controls shall operate as described in their relevant AHU section.

2.8 12 MONTH DEFECTS PERIOD MAINTENANCE

During the 12 month defects period the Contractor shall carry out the maintenance of the newly installed equipment. This shall apply to the following items:

- New Condensing Boilers
- New variable speed pumps for heating and cooling circuits
- New Pressurisation Units for heating and cooling circuits
- Air Handling Unit Motorised Dampers
- 2 Port Valves
- New Dehumidifiers to assist with controlling environmental conditions
- New Building Management System

Boilers shall be serviced and issued with a 12 month gas safety certificate just prior to the end of the defects period.

Pressurisation units and expansion vessels shall have the system pressures checked and adjusted as necessary. High and low level alarm status shall be checked.

The BMS Contractor shall return to site prior to the end of the 12 months defects period to ensure correct operation and to adjust any set points or software configurations that the site staff or engineer feels appropriate.

Motorised dampers and valves shall be cleaned and lubricated and their operation checked.

The dehumidifiers shall have the cases removed, internals vacuumed, filter cleaned and reassembled.

All maintenance duties shall be in accordance with the equipment manufacturers recommendations. If no servicing of the equipment is required during the 12 months the Contractor shall allow for a site visit and function check prior to the end of the 12 months defects period.

PENLEE GALLERY & MUSUEM
MECHANICAL AND ELECTRICAL PLANT REFURBISHMENT

Tender Drawings
Refer to Drawing Issue Sheet

Schedule 1 Document Issue Schedule

End of report.

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