TPS

# Department For International Development

## Inspection of Air Conditioning System



Prepared by

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Approved by

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Prepared for

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c/o DFID
1 Palace Street
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19th June 2009

**CLIENT**
Carillion Planned
Maintenance
c/o DFID
1 Palace Street
London
SW1E 5HE

**JOB TITLE**
DFID
Inspection of Air
Conditioning System

**REFERENCE**
111187

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| Report and Record Sheet | 1 | R | E |
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**Purpose of Issue:**

P = Preliminary
T = Tender
B = Bid
R = Review
C = Construction
F = Final Report
M = PMI
I = Information

# Index

# 1 Executive Summary

## 1.1 EU DIRECTIVE 2002/91/EC – ENERGY PERFORMANCE OF BUILDING

This report has been prepared to meet the requirements of Energy Performance of Buildings Directive Article 9 Inspection of Air Conditioning Systems and is valid for a period of five years.

This report highlights recommendations for increased energy efficiency through plant optimisation. DFID should consider the merit of adding additional routines to meet the aspirations of the EPBD Article 9 as outlined in section 1.3 General Observations and Advice, also Section 5 Summary of Findings and Recommendations.

## 1.2 REGULATION (EC) 842/2006 – F GAS REGULATIONS

These regulations place restrictions on the use and movement of certain fluorocarbon gasses together with such remedial measures as leak detection, monitoring or gas replacement.

**Recommendation** – The contractor currently responsible for the routine PPM, inspections for the Chiller installations should confirm that their operatives are "competent" (in terms of the training and certification requirements of the F-Gas Regulations).

**Recommendation** - A log book in accordance with the F-Gas Regulations (and also O–Gas Regulations) should be prepared, if it is not already, to record the PPM inspections and in particular record the results of the leak detection tests carried out at each PPM inspection, records of all remedial works carried out, especially where this involves the installation of additional refrigerant all generally in accordance with F-Gas / O-Gas Regulations.

**Recommendation** – Automatic Leak Detection within chiller plantroom needs to be installed as this centralised system holds more refrigerant than the 300kg stipulated level. (Actual centralised system R134a refrigerant charge is 2 x 776kg = 1552kg).

## 1.3 GENERAL OBSERVATIONS AND ADVICE

The general condition of the mechanical installation appeared to be kept to a very good standard in clean well managed plantrooms. Whilst a full set of recommendations are given in Section 5, we list below some recommendations that could achieve considerable energy savings with minimum investment.

**Recommendation** – Review internal set point temperatures with user.

**Recommendation** – Review control deadbands on between heating and cooling operations on each system to inhibit simultaneous use.

# 2 Property Inspector Details

## 2.1 PROPERTY INSPECTED

Department For International Development (DFID)

1 Palace Street

London

SW1E 5HE

## 2.2 BUILDING MANAGER

Carillion Planned Maintenance

1 Palace Street

London

SW1E 5HE

## 2.3 INSPECTOR

C J Drury

TPS

Commercial Quay

86 Commercial Street

Leith

Edinburgh EH6 6LX

# 3 Systems Inspected

## 3.1 GENERAL DESCRIPTION

The building is an office block complex occupied by the HM Government's Department For International Development (DFID). The building is an amalgamation of two refurbished 19th century buildings joined together with a modern office block and atrium complex in 2001. The complex is situated on the corners of Palace Street, Buckingham Gate and Stafford Place and comprises office accommodation on 10 levels with a basement car park located in the lower ground floor (Level 1). Plant is generally located either in the basement (Level 0) or on the roof.

The air conditioning system consists of 2 No. water cooled chillers arranged for parallel operation normally running. The chillers serve a primary chilled water circuit (6°C flow - 12°C return) which in turn serves the following 4 No secondary chilled water circuits:

1. Air handling Unit (AHU) chilled water circuit
2. South Building Fan Coil Unit (FCU) chilled water circuit
3. West Building FCU chilled water circuit
4. North/East Building FCU chilled water circuit

The AHU chilled water circuit serves 9 No cooling coils on air handling units for the following areas:

1. South & West Buildings (FCU primary air)
2. West Building (FCU primary air)
3. West Building Conference (FCU primary air)
4. South & West Buildings Toilets
5. North/East Buildings (FCU primary air)
6. East Building Toilets
7. South Building (FCU primary air)
8. Atrium
9. Kitchen/Restaurant

The 3No secondary FCU chilled water circuits operate at a higher temperature regime (11°C flow - 15°C return).

A condensing water circuit takes the heat rejected from the chillers to 6 No. dry air blast coolers arranged in parallel to maintain chiller condensing water return temperature.

There are also 23 No. packaged systems throughout the buildings, the majority of which serves server/patch rooms.

## 3.2 EQUIPMENT

**Chiller No 1**

Manufacturer: York International Ltd

Model No York Millennium Screw Chiller YSFC FA S55 CKD  Serial No 21763

Internal Package Screw Chiller with water cooled condenser

Rated cooling capacity 1185 kW

**Chiller No 2**

Manufacturer: York International Ltd

Model No York Millennium Screw Chiller YSFC FA S55 CKD  Serial No 21762

Internal Package Screw Chiller with water cooled condenser

Rated cooling capacity 1185 kW

**Air Handling Unit No 1**

Manufacturer: Holland Heating Ltd

Double deck air handling unit with:

Supply Unit – 4.0 $m^3/s$ @ 500Pa

Extract Unit – 3.2 $m^3/s$ @ 500Pa

Supply side consists of intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

Extract side consists of extract fan and exhaust damper.

**Air Handling Unit No 2**

Manufacturer: Holland Heating Ltd

Double deck air handling unit with:

Supply Unit – 7.2 $m^3/s$ @ 500Pa

Extract Unit – 6.78 $m^3/s$ @ 500Pa

Supply side consists of intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

Extract side consists of extract fan and exhaust damper.

**Air Handling Unit No 3**

Manufacturer: Holland Heating Ltd

Inline air handling unit with:

Supply Unit – 0.83 $m^3/s$ @ 250Pa

Extract Unit – 0.83 $m^3/s$ @ 250Pa

Supply side consists of intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

Extract side consists of extract fan and exhaust damper.

**Air Handling Unit No 4**

Manufacturer: Holland Heating Ltd

Inline air handling unit with:

Supply Unit – 2.3 $m^3/s$ @ 250Pa

Intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

**Air Handling Unit No 5**

Manufacturer: Holland Heating Ltd

Double deck air handling unit with:

Supply Unit – 7.5 m³/s @ 500Pa

Extract Unit – 7.0 m³/s @ 500Pa

Supply side consists of intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

Extract side consists of extract fan and exhaust damper.

**Air Handling Unit No 6**

Manufacturer: Holland Heating Ltd

Inline air handling unit with:

Supply Unit – 1.72 m³/s @ 300Pa

Intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

**Air Handling Unit No 7**

Manufacturer: Holland Heating Ltd

Inline air handling unit with:

Supply Unit – 8.73 m³/s @ 700Pa

Intake damper, frost coil, panel filter, bag filter, cooling coil, reheat coil and supply fan.

**Air Handling Unit No 12**

Manufacturer: Moducel Ltd

Type 2.5H x 3W weatherproof

Double stack air handling unit with:

Supply Unit – 5.07 m³/s @ 400Pa

Extract Unit – 6.04 m³/s @ 400Pa

Supply side consists of mixing dampers, panel filter, cooling coil, heating coil, frost coil and supply fan.

Extract side consists of extract fan and mixing damper.

**Air Handling Unit No 17**

Manufacturer: Moducel Ltd

Type 2.0M x 2.5W weatherproof

Inline air handling unit with:

Supply Unit – 3.06 m³/s @ 500Pa

Intake damper, panel filter, heating coil, frost coil, cooling coil and supply fan.

**Fan Coil Units**

Manufacturer: Lennox

Type: Various

Each fan coil unit consists of EU2 filter, 2 No forward curved centrifugal type fans with double spindle multispeed motor, cooling coil, heating coil including condensate drain tray.

**Dry Air Blast Coolers**

Manufacturer: G F Cntner UK

Type: S-GFH 082 C/2x5 N (D) B6-2P (6 number)

**Packaged Units**

In accordance with CIBSE only 10% (3 No.) of the 21 packaged units on site were sampled.

The three units sampled were:

Unit 01: Mitsubishi Mr Slim PU- P1.6VGAA serial 10000212 rated cooling capacity 4.5kW

Unit 02: Daikin RS50EVMB serial 4901021 rated cooling capacity 1.7 kW

Unit 03: Mitsubishi PU- P4YGAA serial 10000379 rated cooling capacity 10.0kW

## 3.3 LOCATION OF EQUIPMENT AND AREAS SERVED

The 2 No. chillers are located in the south plantroom on the basement level 0.

Heat rejection from the chillers is via 6 No. dry blast coolers all of which are rooftop located (2 located on the East Building and 4 located on the South Building roofs)

Air handling units Nos 1 – 7 & 12 are also located on the roof top.

Air handling unit No 1 is the South & West Buildings Air Handling Plant and provides conditioned fresh air to fan coil units located in the South building (part) and West building (South) (not including West building level 10). The plant also extracts vitiated air from these areas.

Air handling unit No 2 is the West Building Air Handling Plant and provides conditioned fresh air to fan coil units located in the East building (North) and West building (North) (not including West building level 10). The plant also extracts vitiated air from these areas.

Air handling unit No 3 is the Conference West Building Air Handling Plant and provides conditioned fresh air to fan coil units located in the Conference West Building. The plant also extracts vitiated air from these areas.

Air handling unit No 4 is the South & West Buildings Toilet Supply Air Handling Plant and provides conditioned fresh air to diffusers located in the South & West Buildings toilets.

Air handling unit No 5 is the East Building Air Handling Plant and provides conditioned fresh air to fan coil units located in the East building. The plant also extracts vitiated air from these areas.

Air handling unit No 6 is the East Building Toilet Supply Air Handling Plant and provides conditioned fresh air to diffusers located in the East Building toilets.

Air handling unit No 7 is the South Building Air Handling Plant and provides conditioned fresh air to fan coil units located in the South building. The plant also extracts vitiated air from these areas.

Air handling unit No 12 is the Atrium Air Handling Plant and provides conditioned fresh/ re-circulated air to supply diffusers located in the atrium. The plant also extracts vitiated air from the atrium.

Air handling unit No 17 is the Kitchen & Restaurant Supply Air Handling Plant and provides conditioned fresh air to diffusers located in the Kitchen & Restaurant. The air handling plant is located in the lower ground/mezzanine plantroom located on level 2.

With regard to the three packaged units sampled, they provide conditioned air from local indoor units to the following areas:

Unit 01: Level 5 Patch room

Unit 02: Level 6 Patch room

Unit 03: Level 3 Security room

# 4 Inspection Findings

## 4.1 MEASUREMENT AND CALCULATIONS

Based on the commissioned primary circuit chilled water flowrate of 94.4l/s, the system can provide a maximum cooling duty of 2370kW for a chilled water temperature regime of 6°C flow and 12°C return.

The primary circuit chilled water has a set point of 7°C.

The AHU chilled water secondary circuit has a flowrate of 50.93l/s providing a cooling duty of 1277kW for a chilled water temperature regime of 7°C flow and 13°C return. The fan coil unit chilled water secondary circuits have a combined flowrate of 69.94l/s providing a combined cooling duty of 1169kW for a chilled water temperature regime of 11°C flow and 15°C return. Therefore the combined chilled water secondary circuits have a combined cooling duty of 2446kW, this cooling duty is a maximum simultaneous demand and does not take into account any load diversity.

The Specific Fan Power was calculated for the nine air handling systems which produced the following results:

| | |
|---|---|
| AHU No 1 | 2.96W/(l/s) |
| AHU No 2 | 2.97W/(l/s) |
| AHU No 3 | 2.38W/(l/s) |
| AHU No 4 | 2.12W/(l/s) |
| AHU No 5 | 2.88W/(l/s) |
| AHU No 6 | 2.46W/(l/s) |
| AHU No 7 | 3.13W/(l/s) |
| AHU No 12 | 2.72W/(l/s) |
| AHU No 17 | 4.02W/(l/s) |

AHUs Nos 7 & 17 exceed the TM44 recommendation of Specific Fan Power being less than 3W/(l/s). Calculations for AHUs Nos 12 &17 were based on motor rating values obtained from O&M data instead of absorbed power which if available, would improve the figures stated above.

## 4.2 INSTALLED EFFICIENCY

- The chillers are screw type with one twin screw compressor per chiller, capacity control is achieved by use of a slide valve which provides fully modulating control from 100% to 10% of full load.
- Whilst both the primary and secondary chilled water pumps are invertor driven they are operated at fixed single speed. The efficiency would be improved if the secondary circuit pumps operated at variable speed by using 2 port control valves instead of using the existing 3 port/4 port control valves.
- All Air Handling Units operate as constant volume systems. The efficiency would be improved if heat recovery devices (thermal wheels or plate heat exchangers

or run around coils) were installed between supply and extract systems. Also the introduction of summer and winter supply set point temperature deadbands to provide free cooling and inhibit simultaneous heating and cooling operations. It is noted that the AHU fan motors are to be replaced with variable speed invertor driven types to achieve greater efficiencies.

- In conclusion, we would suggest that the overall efficiency of the air conditioning system should be considered as likely to be lower than currently accepted due to aspects of design or use.

## 4.3 FAULTS IDENTIFIED

At the time of inspection, control issues were identified on Air Handling Units Nos 2, 6 & 12, Carillion Planned Maintenance are resolving these issues with their Control Service Provider.

## 4.4 MAINTENANCE REGIME

A regular routine inspection maintenance regime is in place with any issues identified recorded and raised as a remedial activity. However no specific maintenance regimes as required by the Pressure Systems Safety Regulations ACOP and F Gas Regulations are currently in place.

## 4.5 CONTROLS AND SENSORS

A comprehensive installation of controls and sensors has been installed as part of the Building Management System (BMS). A routine inspection regime is in place with any issues identified raised as remedial activities. No evidence was found of re-calibration of the various sensors installed throughout the installation.

## 4.6 COOLING LOADS

- The total chiller capacity is 2370kW (2 x 1185kW) operating on lead/lag basis. The chiller capacity approximately matches the peak design load (2466kW)
- From data provided by Carillion Planned Maintenance it is estimated that the maximum peak cooling load is approximately 1300kW which is 55% of operating chiller capacity (2370kW).
- Consideration should also be given to reviewing set point temperatures (particularly AHU No 2) to see if it can be increased and in doing so, reduce the cooling load.
- Consideration should also be given to introducing deadbands between cooling and heating operations at AHUs and fan coil units to inhibit simultaneous operation of heating and cooling equipment at each AHU and fan coil unit.

## 4.7 ALTERNATIVE SOLUTIONS

### 4.7.1 Free Cooling

Within the recommendations it is suggested that serious consideration be given to minimising the periods the chiller plant is enabled. With free cooling, heat is rejected from the chilled water circuit to atmosphere via the dry air blast coolers direct without operating the chiller plant. This would entail the introduction of a heat exchanger to the chilled water circuit transferring heat to a separate water circuit which rejects heat through the dry air blast coolers. However this technology is dependant on low air temperatures and further feasibility work is required.

### 4.7.2 Absorption Cooling with CHP

When considering chiller replacement, consideration should also be given to absorption cooling with CHP. These make use of heat generated by CHP plant in summer, when there is little heat, to provide cooling. This would reduce the use of electric vapour compression refrigeration systems and may increase the proportion of the year where CHP might usefully be operated.

### 4.7.3 Efficient Cooling Units

To achieve better chiller efficiency both chiller sizing and performance need to be reviewed when considering chiller replacement. The current chillers can produce a cooling load of 2350kW whilst the actual worst case cooling demand of the building is approximately 1300kW. If the chillers were sized closer to actual cooling loads greater efficiencies of operation would be achieved. When selecting new chiller plant, it's performance data must satisfy current standards as stipulated in the Non Domestic Heating, Cooling and Ventilation Guide. Products listed in the Energy Technology List meet specific standards and are eligible for Enhanced Capital Allowance scheme.

# 5 Summary of Findings and Recommendations

## 5.1 MAINTENANCE

Routine PPM inspections take place on the Chiller plant and Air Handling plant on a daily basis. The routine PPM inspections identify remedial issues that are addressed as required. The general condition of the plant and plantrooms is very good with plant seemingly operating satisfactorily without complaint from the building users.

**Recommendation** – The contractor currently responsible for the routine PPM, inspections for the Chiller installations should confirm that their operatives are "competent" (in terms of the training and certification requirements of the O-Gas / F-Gas Regulations).

**Recommendation** - A log book in accordance with the O–Gas / F-Gas Regulations should be prepared, if it is not already, to record the PPM inspections and in particular record the results of the leak detection tests carried out at each PPM inspection, records of all remedial works carried out, especially where this involves the installation of additional refrigerant all generally in accordance with O-Gas / F-Gas Regulations.

**Recommendation** – To comply with F-Gas Regulations, Automatic Leak Detection within chiller plantroom needs to be installed as the centralised system holds over 300kg of R134a refrigerant (actual refrigerant charge is 2 x 776kg).

**Recommendation –** To comply with the Pressure Systems Safety Regulations 2000, statutory inspections and reports in accordance with the ACOP for Pressure Systems Safety Regulations 2000 need to be actioned/produced. The written scheme produced should make recommendations with regard to the frequency of testing of the chiller pressure relief valves.

## 5.2 USAGE / METERING

The mechanical plant for the main building is controlled via a BMS system with time clock control to operate the mechanical plant during the building user occupied periods. No other metering was in evidence during the on site inspection. The hours run information for two chillers was available but this would require access to the chiller plant to take readings.

**Recommendation** – The BMS installation could be configured, (if it not configured already) to record the hours run on each compressor or at least the hours run on each Chiller, then regular readings be taken to monitor and record actual chiller run hours.

## 5.3 CONTROL SENSORS

From the site inspection it would appear that sufficient control sensors are installed throughout the air conditioning installation to allow close control of the system. However no evidence was seen of regular calibration of the control sensors.

**Recommendation** – Maintain records of calibration checks.

## 5.4 SET TEMPERATURES

From the site inspection it would appear that the set points for the chiller and air Conditioning installation set at the building hand-over remain in place today.

**Recommendation** – The BMS should be set up (if it not configured already) to schedule the chilled water flow temperature to take advantage of seasonal changes in external air temperature.

**Recommendation** – The Chillers should be held off until a prescribed number of AHU chilled water diverting valves meet an agreed percentage opening.

**Recommendation** – AHU air supply set points should be reviewed and deadbands set up between cooling and heating operations to inhibit simultaneous operations and provide free cooling.

## 5.5 PACKAGED UNITS

Consider installing hours run or energy meters to monitor use of systems.

**Recommendation** – Consider resetting internal temperature set points for Patch room packaged units to 22°C or higher.

**Recommendation** – When replacement becomes necessary, consider smaller capacity units if IT rack/security equipment has been replaced with low energy systems.

# 6 Appendix 1: Site inspection details

**Pre Site visit work items:**

Notes to the inspector: this downloadable survey template is for the inspection of one single centralised system, if a site has multiple systems one record sheet will require to be completed for each system

| Building – Control Reporting Centre (CRC) | | | |
|---|---|---|---|
| Organisation Name | Carillion Planned Maintenance Ltd | | |
| Building owner/manager | John Padmore | | |
| Street Address | DFID | | |
| | 1 Palace Street | | |
| | | | |
| | | | |
| City | London | Postcode | SW1E 5HE |

| Building occupier | | | |
|---|---|---|---|
| Organisation Name | DFID | Telephone | |
| Street Address | 1 Palace Street | | |
| City | London | Postcode | SW1E 5HE |

| Accredited inspector details | | | |
|---|---|---|---|
| Inspector Name | C J Drury | Accreditation Scheme | CIBSE |
| Trading Name | TPS | | |
| Trading Address | Commercial Quay<br>86 Commercial Street<br>Leith<br>Edinburgh EH6 6LX | | |

Note: Request following information from client and complete the following checklist. The inspector should examine the relevant documentation and systems as far as possible to check that the installed equipment is as described. If the documentation is not available, then an additional part of this procedure is to locate the equipment and assemble a minimum portfolio of relevant documentation.

| Record Checklist Pre Inspection Information | | | |
|---|---|---|---|
| Level | Information Required | Issues | Not Available |
| Essential | Itemised list of installed air conditioning and refrigeration plant including product makes, models and identification numbers. | Provided | |
| | Cooling capacities, with locations of the indoor and outdoor components of each plant. | Provided | |
| | Description of system control zones, with schematic drawings. | Provided | |
| | Description of method of control of temperature. | Provided | |
| | Description of method of control of periods of operation. | Provided | |
| | Floor plans and schematics of air conditioning systems. | Provided | |
| Desirable | Reports from earlier inspections of air conditioning systems, and for the generation of an energy performance certificate | | Not Available |
| | Records of maintenance operations carried out on refrigeration systems, including cleaning indoor and outdoor heat exchangers, refrigerant leakage tests, repairs to refrigeration components or replenishing with refrigerant. | Available | |
| | Records of maintenance operations carried out on air delivery systems, including filter cleaning and changing, and cleaning of heat exchangers. | Available | |
| | Records of calibration and maintenance operations carried out on control systems and sensors, or BMS systems and sensors. | | Not Available |
| | Records of sub-metered air conditioning plant use or energy consumption. | | Not Available |
| | For relevant air supply and extract systems, commissioning results of measured absorbed power at normal air delivery and extract rates, and commissioning results for normal delivered delivery and extract air flow rates (or independently calculated specific fan power for the systems). | Data based on O&M information | |
| Optional | An estimate of the design cooling load for each system (if available). Otherwise, a brief description of the occupation of the cooled spaces, and of power consuming equipment normally used in those spaces. | Provided | |
| | Records of any issues or complaints that have been raised concerning the indoor comfort conditions achieved in the treated spaces. | Verbally Provided | |
| | Where a BMS is used the manager should arrange for a short statement to be provided describing its capabilities, the plant it is connected to control, the set points for the control of temperature, the frequency with which it is maintained, and the date of the last inspection and maintenance | Available during inspection | |
| | Where a monitoring station, or remote monitoring facility, is used to continually observe the performance of equipment such as chillers, the manager should arrange for a statement to be provided describing the parameters monitored, and a statement reviewing the operating efficiency of the equipment. | | Not Available |

For further guidance on pre-inspection information see TM44 Section 3.1

Note: Once information received by inspector, arrange to visit site to undertake inspection.

## Site visit work items:

## Chiller No 1

| Cooling Plant Equipment inspected<br>Note: Verify information provided by client is correct by way of inspection and insert actual verified information in fields below. See TM44 Section 3.2.1 | |
|---|---|
| Manufacturer | York International Ltd |
| Description | Internal Package Screw Chiller with water cooled condenser |
| Model / Reference | York Millennium Screw Chiller YSFC FA S55 CKD |
| Serial Number | 21763 |
| Year plant installed | 2001 |
| Rated Cooling Capacity (kW) | 1185kW |
| Refrigerant Type | R134a |
| Location | Level 0 South Plantroom |
| Areas / Systems Served | DFID building – in conjunction with another 1 No identical chiller (Chiller No 2), serving primary chilled water to 8 No air handling units and secondary chilled water to various fan coil units located throughout the building. |

| Note below any discrepancy between information provided by client and on site information collected: |
|---|
| None |
| |
| |
| |

| Cooling Plant Equipment Visual inspection<br>Note: Note whether the plant appears clean and unobstructed. If dirty and cluttered, then regular inspection and maintenance is unlikely. This should be noted; recommend the plant is kept clear and properly maintained. Visual signs of refrigerant leakage should be noted and evidence of attention to any leakage sought. If none found recommend prompt skilled maintenance. | |
|---|---|
| Is chiller and heat rejection plant operational? | Yes |
| Is area around chiller & heat rejection plant clear of obstructions & debris? | Yes ☒ |
| Is there any possibility of air recirculation through the condenser. | No ☒ |

| | |
|---|---|
| Is general condition of chiller and associated central plant in good order? | Yes ☒ As far as can be seen |
| Are condenser heat exchangers undamaged/ un-corroded and clean? | Shell & tube condenser - could not be inspected |
| Assess temperature difference / and observe refrigerant via sight glass or pressure gauge. Suitable? | Refrigerant temperature difference across compressor - could not be inspected. Circuit chilled water flow and return temperatures witnessed at 7.7C and 7.9C respectively. No refrigerant gas bubbles or liquid level lines were observed via sight glass. |
| Does area around plant show signs of oily stains indicative of a refrigerant leak? | No ☒ |
| Is insulation on primary circulation pipe work well fitted and in good order? | Yes ☒ |
| Is the chiller unit placed clear from warm air discharge louvers | Yes ☒ |
| Locate compressors and ensure they are operational or can be brought into operation | Confirm that chiller arrangement is operational with circuit chilled water flow and return temperatures witnessed at 7.7C and 7.9C respectively at BMS. |

| Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Appropriately Sized Cooling Plant | Compare system sizes with likely loads. Section 4 TM44 contains simple procedures for assessing whether refrigeration systems and air supply systems are likely to be oversized. | **Following Information Required:**<br><br>Total Occupants 800 (approx)<br><br>Total Floor Area 16400<br><br>Occupant density $m^2$ / person 20<br><br>Lower level heat gain 20 W / $m^2$<br><br>Upper level heat gain 35 W / $m^2$<br><br>Installed Cooling Capacity 2x 1185 = 2370 kW<br><br>Chillers installed 2No in parallel (2 x 1185kW) designed to operate with 2 chillers running (lead/lag). Total available chiller duty is 2370kW.<br><br>Commissioned total chilled water flowrate is 94.4 l/s which equates to 2370kW @ 7/13C chilled water | *Create a dynamic simulation of the building when replacing the chillers.* |

| | | | |
|---|---|---|---|
| | | flow/return temps.<br><br>Total cooling coil duties is approx 2246.39kW<br><br>Estimated cooling load is 16400m² x 35W/m² = 574kW<br><br>Maintenance staff feedback is that lag chiller is occasionally operated suggesting that worst case cooling load is around the 1300kW mark. A site chiller efficiency study also suggests that the average cooling load of 600kW/August weekday.<br><br>**The installed size is deemed:**<br><br>The installed chiller size is deemed 82% oversized for the building's current requirements. | |
| Refrigerant used | Identify the refrigerant used.<br><br>Indicate where and F-Gas Regulations inspection may be required | Refrigerant name R134a<br><br>F-Gas refrigerant requiring regular leakage inspection?<br><br>Yes ☒ The chiller refrigerant load is 776kg | |
| Refrigeration Charge | In operation observe the temperature difference across the refrigeration compressor. Compared with the ambient temperature in the plant room / outside air. | Refrigeration Temperature:<br><br>Pre compressor<br><br>Post Compressor<br><br>**The temperature deemed:**<br><br>Could not be inspected | If, while the refrigeration plant is operating, both flow and return appear to be at the same temperature, or warmer than the surroundings, then it may be that the equipment has lost its refrigerant charge, although this may not be the only cause. |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>No ☒<br><br>No stains witnessed but previous maintenance inspection report states minor leaks at safety valve spool valve. | |
| Water cooled chillers | If the refrigeration equipment includes water chillers check that adequate water flows are available through the condensers and evaporators to achieve efficient heat transfer. Also check that the water pressure drops | Is the chiller water cooled<br><br>Yes ☒ if yes insert detail as follows:<br><br>Flow Reading Condenser l/s | If, not the same and there is no evidence that the flow was changed for a reason, provide advice to re commission to design ntent. |

| | | | |
|---|---|---|---|
| | across them are in accordance with design or commissioning data if gauges or test points are available and accessible.<br><br>Check that chilled and hot water are not being supplied to terminals simultaneously | Could not be inspected – no flow rate meters<br><br>Commissioning flow rate l/s<br><br>O&M Manual indicates a condenser water flowrate of 160l/s and Record drawing 1274/RD/M700 indicates a condenser water flowrate of 157.26l/s. No commissioning results available.<br><br>Yes ☒ | |
| Regular Maintenance | Record whether there is evidence of a regular inspection and maintenance regime carried out by suitably competent people. Record and comment on the frequencies and scope of maintenance to the air conditioning equipment and systems in relation to industry guidelines. This, and the dates of most recent maintenance may also need to be referred to during the 'physical' inspection. | Are there records of regular maintenance<br><br>Yes ☒<br><br>Is the maintenance undertaken by suitably competent people<br><br>Yes ☒<br><br>Provide comment regarding maintenance frequencies in relation to industry guidelines:<br><br>F Gas/Chiller inspections carried out every 3 months, all AHU filters replaced/cleaned every 3 months, all Fan Coil units have maintenance inspection frequency of 6 months including the replacement or cleaned of filters. Maintenance frequencies are deemed acceptable in line with HVCA SFG20. | |
| Metering | Is metering installed to enable monitoring of energy consumption of refrigeration plant.<br><br>Is a BEMs installed in the building which can warn out of range values? | Yes ☒ No ☐<br><br>Yes ☒ No ☐ | *[No metering or records: Consider installing hour's run or energy meters to monitor use of systems].* |

## Chiller No 2

| Cooling Plant Equipment inspected<br>Note: Verify information provided by client is correct by way of inspection and insert actual verified information in fields below. See TM44 Section 3.2.1 | |
|---|---|
| Manufacturer | York International Ltd |
| Description | Internal Package Screw Chiller with water cooled condenser |
| Model / Reference | York Millennium Screw Chiller YSFC FA S55 CKD |
| Serial Number | 21762 |
| Year plant installed | 2001 |
| Rated Cooling Capacity (kW) | 1185kW |
| Refrigerant Type | R134a |
| Location | Level 0 South Plantroom |
| Areas / Systems Served | DFID building – in conjunction with another 1 No identical chiller (Chiller No 1), serving primary chilled water to 8 No air handling units and secondary chilled water to various fan coil units located throughout the building. |

| Note below any discrepancy between information provided by client and on site information collected: |
|---|
| None |
| |
| |
| |

| Cooling Plant Equipment Visual inspection<br>Note: Note whether the plant appears clean and unobstructed. If dirty and cluttered, then regular inspection and maintenance is unlikely. This should be noted; recommend the plant is kept clear and properly maintained. Visual signs of refrigerant leakage should be noted and evidence of attention to any leakage sought. If none found recommend prompt skilled maintenance. | |
|---|---|
| Is chiller and heat rejection plant operational? | Yes |
| Is area around chiller & heat rejection plant clear of obstructions & debris? | Yes ☒ |
| Is there any possibility of air recirculation through the condenser. | No ☒ |
| Is general condition of chiller and associated central plant in good order? | Yes ☒ As far as can be seen |

| | |
|---|---|
| Are condenser heat exchangers undamaged/ un-corroded and clean? | Shell & tube condenser - could not be inspected |
| Assess temperature difference / and observe refrigerant via sight glass or pressure gauge. Suitable? | Refrigerant temperature difference across compressor - could not be inspected. Circuit chilled water flow and return temperatures witnessed at 7.7C and 7.9C respectively. No refrigerant gas bubbles or liquid level lines were observed via sight glass. |
| Does area around plant show signs of oily stains indicative of a refrigerant leak? | No ☒ |
| Is insulation on primary circulation pipe work well fitted and in good order? | Yes ☒ |
| Is the chiller unit placed clear from warm air discharge louvers | Yes ☒ |
| Locate compressors and ensure they are operational or can be brought into operation | Confirm that chiller arrangement is operational with circuit chilled water flow and return temperatures witnessed at 7.7C and 7.9C respectively at BMS. |

| Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Appropriately Sized Cooling Plant | Compare system sizes with likely loads. Section 4 TM44 contains simple procedures for assessing whether refrigeration systems and air supply systems are likely to be oversized. | **Following Information Required:**<br><br>Total Occupants 800 (approx)<br><br>Total Floor Area 16400<br><br>Occupant density $m^2$ / person 20<br><br>Lower level heat gain 20 W / $m^2$<br><br>Upper level heat gain 35 W / $m^2$<br><br>Installed Cooling Capacity 2x 1185 = 2370 kW<br><br>Chillers installed 2No in parallel (2 x 1185kW) designed to operate with 2 chillers running (lead/lag). Total available chiller duty is 2370kW.<br><br>Commissioned total chilled water flowrate is 94.4 l/s which equates to 2370kW @ 7/13C chilled water flow/return temps.<br><br>Total cooling coil duties is approx 2246.39kW | *Create a dynamic simulation of the building when replacing the chillers.* |

| | | | |
|---|---|---|---|
| | | Estimated cooling load is 16400m² x 35W/m² = 574kW<br><br>Maintenance staff feedback is that lag chiller is occasionally operated suggesting that worst case cooling load is around the 1300kW mark. A site chiller efficiency study also suggests that the average cooling load of 600kW/August weekday.<br><br>**The installed size is deemed:**<br><br>The installed chiller size is deemed 82% oversized for the building's current requirements. | |
| Refrigerant used | Identify the refrigerant used.<br><br>Indicate where and F-Gas Regulations inspection may be required | Refrigerant name R134a<br><br>F-Gas refrigerant requiring regular leakage inspection?<br><br>Yes ☒ The chiller refrigerant load is 776kg | |
| Refrigeration Charge | In operation observe the temperature difference across the refrigeration compressor. Compared with the ambient temperature in the plant room / outside air. | Refrigeration Temperature:<br><br>Pre compressor<br><br>Post Compressor<br><br>**The temperature deemed:**<br><br>Could not be inspected | If, while the refrigeration plant is operating, both flow and return appear to be at the same temperature, or warmer than the surroundings, then it may be that the equipment has lost its refrigerant charge, although this may not be the only cause. |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>No ☒<br><br>No stains witnessed. | |
| Water cooled chillers | If the refrigeration equipment includes water chillers check that adequate water flows are available through the condensers and evaporators to achieve efficient heat transfer. Also check that the water pressure drops across them are in accordance with design or commissioning data if gauges or test points are available and accessible. | Is the chiller water cooled<br><br>Yes ☒ if yes insert detail as follows:<br><br>Flow Reading Condenser l/s<br><br>Could not be inspected – no flow rate meters<br><br>Commissioning flow rate l/s | If, not the same and there is no evidence that the flow was changed for a reason, provide advice to re commission to design ntent. |

| | | | |
|---|---|---|---|
| | Check that chilled and hot water are not being supplied to terminals simultaneously | O&M Manual indicates a condenser water flowrate of 160l/s and Record drawing 1274/RD/M700 indicates a condenser water flowrate of 157.26l/s. No commissioning results available.<br><br>Yes ☒ | |
| Regular Maintenance | Record whether there is evidence of a regular inspection and maintenance regime carried out by suitably competent people. Record and comment on the frequencies and scope of maintenance to the air conditioning equipment and systems in relation to industry guidelines. This, and the dates of most recent maintenance may also need to be referred to during the 'physical' inspection. | Are there records of regular maintenance<br><br>Yes ☒<br><br>Is the maintenance undertaken by suitably competent people<br><br>Yes ☒<br><br>Provide comment regarding maintenance frequencies in relation to industry guidelines:<br><br>F Gas/Chiller inspections carried out every 3 months, all AHU filters replaced/cleaned every 3 months, all Fan Coil units have maintenance inspection frequency of 6 months including the replacement or cleaned of filters. Maintenance frequencies are deemed acceptable in line with HVCA SFG20. | |
| Metering | Is metering installed to enable monitoring of energy consumption of refrigeration plant.<br><br>Is a BEMs installed in the building which can warn out of range values? | Yes ☒ No ☐<br><br>Yes ☒ No ☐ | *[No metering or records: Consider installing hour's run or energy meters to monitor use of systems].* |

## Chiller Nos 1 & 2

| Cooling Systems Equipment Inspection | |
|---|---|
| No Systems | 1. No centralised cooling plant consisting 2 no chillers arranged in parallel located in the Basement Level 0 South plantroom with 6 No Dry Air Blast Coolers located on the rooftop. |
| Systems Served from cooling plant | 1. No centralised cooling plant consisting 2 no chillers arranged in parallel serving a primary chilled water circuit which serves 4 No secondary chilled water circuits. 3 No secondary chilled water circuits serve fan coil units on 10 levels throughout the building and remaining secondary chilled water circuit serves 8 No rooftop Air Handling Units. |
| Manufacturer(s) | Air Handling Units – Holland Heating Ltd & Moducel Ltd<br><br>Fan Coil Units – Lennox |
| Year systems installed | Air Handling Units – Holland Heating Ltd - 2001<br><br>Air Handling Unit – Moducel Ltd – circa 1992<br><br>Fan Coil Units – Lennox – 2001 |
| Location | Throughout DFID Buildings |
| Areas / Systems Served | Local Spaces |

Controls and sensors

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Insulation | Visually inspect the route and condition of the cooling system pipework serving local areas.<br><br>Check that pipework or ductwork (or both) is appropriately insulated. | Is pipework adequately insulated?<br><br>Yes ☒<br><br>Is ductwork adequately insulated?<br><br>Yes ☒ | |
| Unit Condition | Visually check the condition and operation of indoor units. | Are the indoor units in good working order?<br><br>Yes | |

| | | | |
|---|---|---|---|
| Grilles & Air Flow | Review air delivery openings, grilles or diffusers, and route by which air is extracted from the spaces.<br><br>Note whether these appear to provide good distribution.<br><br>Review evidence that occupants find the air delivery arrangements unacceptable – for example check the complaints log (if it is available) | Are diffusers /grilles clean and in good order?<br><br>Yes ☒<br><br>No complaints noted. | |
| Diffuser Positions | Assess the positioning and geometry of air supply openings in relation to extract openings.<br><br>Observe if partitioning or furniture is affecting performance. | Are the diffusers and grilles clean and in good order:<br><br>Yes ☒ | |

## AHU No 1

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 1 South & West Buildings Air Handling Plant** |
| Systems Served from cooling plant | Fan coil units located in the South Building (part) and West Building (South) (not including West Building – Level 10). |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to fan coil units located in the South Building (part) and West Building (South) (not including West Building – Level 10). |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 1 Supply Fan Duty: 4.0m3/s @ 500Pa, absorbed power 7.57kW. Supply SPF = 1.89<br><br>AHU 1 Extract Fan Duty: 3.2m3/s @ 500Pa, absorbed power 3.41kW. Extract SPF = 1.07<br><br>Total SPF = 2.96 |
| Condition of Heat | Assess condition of heat exchangers. Note whether any heat exchanger | Are heat exchangers in good condition | |

| | | | |
|---|---|---|---|
| Exchangers | surfaces are significantly damaged, or blocked by debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | Yes<br><br>If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Backward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |

| | | | |
|---|---|---|---|
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. Associated Fan Coil Units are controlled by local Trend controllers with return air or wall mounted temperature sensors. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 20°C whilst the Fan Coil Units have summer and winter set points of 22°C & 21°C respectively. Therefore there is a 1ºC deadband. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 2

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 2 West Building Air Handling Plant** |
| Systems Served from cooling plant | Fan coil units located in the East Building (North) and West Building (North) (not including West Building – Level 10). |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to fan coil units located in the East Building (North) and West Building (North) (not including West Building – Level 10). |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 2 Supply Fan Duty: 7.2m3/s @ 500Pa, absorbed power 13.27kW. Supply SPF = 1.84<br><br>AHU 2 Extract Fan Duty: 6.78m3/s @ 500Pa, absorbed power 7.65kW. Extract SPF = 1.13<br><br>Total SPF = 2.97 |
| Condition of Heat | Assess condition of heat exchangers. Note whether any heat exchanger | Are heat exchangers in good condition | |

| | | | |
|---|---|---|---|
| Exchangers | surfaces are significantly damaged, or blocked by debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | Yes<br><br>If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Backward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |

| | | | |
|---|---|---|---|
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. Associated Fan Coil Units are controlled by local Trend controllers with return air or wall mounted temperature sensors. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 20°C whilst the Fan Coil Units have summer and winter set points of 22°C & 21°C respectively. Therefore there is a 1ºC deadband.<br><br>During inspection, temperature recorded downstream of frost coil was 18°C whilst outside air temperature was at 17.4°C, however the cooling coil was operating at 54% to achieve supply set point of 18°C. Control rectification work is required | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 3

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 3 Conference West Building Air Handling Plant** |
| Systems Served from cooling plant | Fan coil units located in the Conference West Building. |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to fan coil units located in the Conference West Building. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 3 Supply Fan Duty: 0.83m3/s @ 250Pa, absorbed power 1.24kW. Supply SPF = 1.49<br><br>AHU 3 Extract Fan Duty: 0.83m3/s @ 250Pa, absorbed power 0.74kW. Extract SPF = 0.89<br><br>Total SPF = 2.38 |
| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by | Are heat exchangers in good condition<br><br>Yes | |

| | | | |
|---|---|---|---|
| | debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Supply - Backward curved double inlet. Constant air speed control.<br><br>Exhaust - Forward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |

| | | | |
|---|---|---|---|
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. Associated Fan Coil Units are controlled by local Trend controllers with return air or wall mounted temperature sensors. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 20°C whilst the Fan Coil Units have summer and winter set points of 22°C & 21°C respectively. Therefore there is a 1ºC deadband. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 4

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 4 Toilet Fresh Air Supply South & West Buildings Air Handling Plant** |
| Systems Served from cooling plant | Supply diffusers located in the South & West Building toilets. |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to supply grilles located in the South & West Building toilets. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 4 Supply Fan Duty: 2.3m3/s @ 250Pa, absorbed power 2.6kW. Supply SPF = 1.13<br><br>EF 7 Extract Fan Duty: 2.6m3/s @ 500Pa, absorbed power 2.58kW. Extract SPF = 0.99<br><br>Total SPF = 2.12 |
| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly | Are heat exchangers in good condition | |

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| | damaged, or blocked by debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | Yes<br><br>If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Backward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |

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| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 18°C, there is no deadband. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake of the AHU respectively. The damper is interlocked with fan operation. | |

## AHU No 5

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 5 East Building Air Handling Plant** |
| Systems Served from cooling plant | Fan coil units located in the East Building. |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to fan coil units located in the East Building. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 5 Supply Fan Duty: 7.5m3/s @ 500Pa, absorbed power 13.09kW. Supply SPF = 1.75<br><br>AHU 5 Extract Fan Duty: 7.0m3/s @ 500Pa, absorbed power 7.9kW. Extract SPF = 1.13<br><br>Total SPF = 2.88 |
| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by | Are heat exchangers in good condition<br><br>Yes | |

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| | debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Backward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |

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| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. Associated Fan Coil Units are controlled by local Trend controllers with return air or wall mounted temperature sensors. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 20°C whilst the Fan Coil Units have summer and winter set points of 22°C & 21°C respectively. Therefore there is a 1ºC deadband. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 6

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 6 Toilet Supply East Building Air Handling Plant** |
| Systems Served from cooling plant | Supply diffusers located in the East Building toilets. |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to supply diffusers located in the East Building toilets. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 6 Supply Fan Duty: 1.72m3/s @ 300Pa, absorbed power 2.16kW. Supply SPF = 1.26<br><br>EF4 Extract Fan Duty: 2.15m3/s @ 500Pa, absorbed power 2.58kW. Extract SPF = 1.2<br><br>Total SPF = 2.46 |
| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by | Are heat exchangers in good condition<br><br>Yes | |

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| | debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Supply - Backward curved double inlet. Constant air speed control.<br><br>Exhaust - Forward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |

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| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Supply air produced by the AHU has a set point is 18°C, there is no deadband. At time of inspection BMS was indicating supply fan failure.<br><br>Temperature recorded downstream of frost coil was 17.6°C whilst outside air temperature was at 19.8°C, however the cooling coil was operating at 42% to achieve supply set point of 18°C. Control rectification work is required | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake of the AHU respectively. The damper is interlocked with fan operation. | |

## AHU No 7

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 7 South Building Air Handling Plant** |
| Systems Served from cooling plant | Fan coil units located in the South Building. |
| Manufacturer(s) | Holland Heating Ltd |
| Year systems installed | 2001 |
| Location | Rooftop |
| Areas / Systems Served | Serves filtered/tempered/fresh air to fan coil units located in the South Building. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Absorbed power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 7 Supply Fan Duty: 8.73m3/s @ 700Pa, absorbed power 18.14kW. Supply SPF = 2.08<br><br>EF5 Extract Fan Duty: 8.0m3/s @ 500Pa, absorbed power 8.37kW. Extract SPF = 1.05<br><br>Total SPF = 3.13 |
| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by | Are heat exchangers in good condition<br><br>Yes | |

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| | debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Backward curved double inlet. Constant air speed control.<br><br>Not applicable - no fresh air/recirculation damper arrangement. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account building orientation and usage. | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |

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| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. Associated Fan Coil Units are controlled by local Trend controllers with return air or wall mounted temperature sensors. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Primary air produced by the AHU has a set point is 20°C whilst the Fan Coil Units have summer and winter set points of 22°C & 21°C respectively. Therefore there is a 1ºC deadband. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 12

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 12 Atrium Air Handling Plant** |
| Systems Served from cooling plant | Supply diffusers & extract grilles in Atrium. |
| Manufacturer(s) | Moducel |
| Year systems installed | Circa 1992 |
| Location | Rooftop |
| Areas / Systems Served | Supply diffusers & extract grilles in Atrium. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Motor rating power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>Specific Fan Power = 2.72<br><br>SFP calculation shows AHU has reasonable SFP however information taken from O&Ms not commissioning data and actual SFP could therefore be higher (or lower) than calculated. | AHU 12 Supply Fan Duty: 5.07m3/s, fan motor rating 7.5kW. Supply SPF = 1.48<br><br>AHU 12 Extract Fan Duty: 6.04m3/s, fan motor rating 7.5kW. Extract SPF = 1.24<br><br>Total SPF = 2.72 |

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| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | Are heat exchangers in good condition<br><br>Could not be inspected<br><br>If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Fan type could not be inspected or ascertained from O&M. Constant air speed control.<br><br>Could not be inspected. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>The AHU has a mixing box with recirculation damper arrangement to allow the mixing of fresh air and exhaust air to conserve energy. Operation witnessed at BMS. | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account usage (atrium) | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |

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| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Supply air produced by the AHU has set points of 19°C & 21°C for heating and cooling respectively. Therefore there is a 2ºC deadband.<br><br>During inspection, temperature recorded downstream of cooling coil and heater battery was 11.6°C whilst outside air temperature was at 17.4°C, however the cooling coil was operating at 77% producing supply air at 21°C (when supply set point is at 21°C) suggesting a 9.4°C rise across fan. The heating and cooling set point graphics are also incorrect. Control rectification work is required | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via on/off dampers situated downstream of the intake and exhaust outlets of supply and extract sides of the AHU respectively. In both cases the dampers are interlocked with fan operation. | |

## AHU No 17

| Air Handling Systems Equipment Inspection | |
|---|---|
| System Reference | **AHU No 17 Kitchen Supply Air Handling Plant** |
| Systems Served from cooling plant | Supply diffusers in Kitchen/Restaurant. |
| Manufacturer(s) | Moducel |
| Year systems installed | Circa 1992 |
| Location | Level 2 – Lower Ground/Mezzanine plantroom |
| Areas / Systems Served | Supply diffusers in Kitchen/Restaurant. |

| Detailed Inspection Notes | | | |
|---|---|---|---|
| Item | Guidance notes | *Inspection Notes* | *Guidance Recommendations* |
| Filters | Check condition of intake air filters and check air inlets and outlets for obstruction.<br><br>Note the usual filter changing or cleaning frequency, and the elapsed time since the last change or clean, in relation to industry guidance. | Inlet and filter conditions acceptable<br><br>Yes ☒<br><br>Changing Frequency 6 Months<br><br>The frequency is deemed:<br><br>Acceptable | |
| Specific Fan Power | Estimate the specific fan power (SFP) of air movement systems, provided that this can be done simply from existing records of the installed fan capacities and the flow rates and pressure drops noted in commissioning records, for comparison with the guidance | *Use the guidance in TM44 section 4.4 tables 4.1 Indicative ventilation rates for various types of buildings (Source BSRIA BG14/2003(20) & 4.2 yardstick installed fan capacities (source BSRIA AG1/2000(21))*<br>Are air flow rates and system pressures available from commissioning data?<br><br>No ☒ (Motor rating power & air flow rate data taken from O&M information)<br><br>*[Undertake SFP calculation is it reasonable i.e. less than 3]*<br><br>Specific Fan Power = 4.02(This calculation is based on information taken from electric motor ratings and does not reflect the absorbed power from the motors therefore the actual SFP should be less than that recorded.) | AHU 17 Supply Fan Duty: 3.06m3/s, fan motor rating 7.5kW. Supply SPF = 2.45<br><br>Extract Fan Duty: 3.5m3/s, fan motor rating 5.5kW. Extract SPF = 1.57<br><br>Total SPF = 4.02 |

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| Condition of Heat Exchangers | Assess condition of heat exchangers. Note whether any heat exchanger surfaces are significantly damaged, or blocked by debris or dust.<br>Where reasonably practical, and where suitable information is available for comparison, the air path resistance across the coil should be measured and compared with the design resistance. | Are heat exchangers in good condition<br><br>Could not be inspected<br><br>If no provide description below: | |
| Refrigeration leaks | Note whether refrigeration heat exchangers show signs of oily staining that could indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records. | Are there any signs of a refrigerant leak<br><br>Not Applicable | |
| Fan & Control | Note the fan type, and method of air speed control.<br><br>Check the setting and operation of any fresh air/recirculation dampers | Fan type could not be inspected or ascertained from O&M. Constant air speed control.<br><br>Could not be inspected. | |
| Heat recovery | Identify whether the systems have any energy conservation facilities, e.g. heat recovery, free cooling sequence, and check for evidence that such facilities are/have been functioning. | Energy Conservation features installed:<br><br>None observed | |
| Air leakage | Observe the air handling plant and visible air containment including ductwork, floor or ceiling plenums and builders' work shafts for signs of excessive leakage and energy loss. | None observed | |
| Outdoor air inlets | (*a*) Locate the inlets for outdoor air.<br>(*b*) Note any significant obstructions or blockages to inlet grilles, screens and pre-filters.<br>(*c*) Note where inlets may be affected by proximity to local sources of heat, or to air exhausts. | Appear clean and free from debris and not in proximity of heat sources or air exhausts. | |
| System Control | Assess zoning in relation to factors such as local levels of internal gain, orientation and exposure to solar radiation. | Zoning is acceptable as it takes into account usage (kitchen & restaurant) | |
| | Note the current indicated weekday and time of day on controllers against the actual time. | BMS day/time indication set up correctly. | |

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|---|---|---|---|
| | Note the set on and off periods (for weekday and weekend if this facility is available with the timer). | Monday to Friday: Set On time 07.00hrs & Set Off time 18.00hrs. | |
| | Identify and assess zone heating and cooling temperature control sensors | AHU is supply temperature set point controlled with a sensor located in supply ductwork down stream of AHU with BMS back indication. | |
| | Note whether a 'dead band' is or can be set between heating and cooling. | Supply air produced by the AHU has a set point of 20°C there appears to be no deadband between heating and cooling. | |
| | Assess the refrigeration compressor(s) and the method of refrigeration capacity control. | The capacity control is achieved by use of a slide valve which provides modulating capacity control from 100% to 10% of full load. | |
| | Assess means of modulating or controlling air flow rate through air supply and exhaust ducts. | The air flow through the AHU is via an on/off damper situated downstream of the air intake at the inlet of the AHU. The damper is interlocked with fan operation. | |

# Packaged cooling system –
# Report of packaged cooling system inspection

| | |
|---|---|
| Organisation | DFID |
| Address | 1 Palace Street, London |
| Building owner/manager | SW1E 5HE |

| | |
|---|---|
| Name of inspector | Mr C Drury, for TPS Consult |
| Date of inspection | 12 May 2009 |

| **Equipment inspected** | |
|---|---|
| Equipment | Unit 01: Mitsubishi Mr Slim PU- P1.6VGAA serial 10000212<br>rated cooling capacity 4.5kW (2.5kg)<br>Unit 02: Daikin RS50EVMB serial 4901021<br>rated cooling capacity 5.0kW (1.2kg)<br>Unit 03: Mitsubishi PU- P4YGAA serial 10000379<br>rated cooling capacity 10.0kW (4.0kg) |
| Location | Unit 01: outdoor located on rooftop<br>Unit 02: outdoor located on rooftop<br>Unit 03: outdoor located on car park ramp |
| Areas served | Unit 01: serves Level 5 Patch Room<br>Unit 02: serves Level 6 Patch Room<br>Unit 03: serves Level 3 Security Room |

| **Inspection of documentation and records** | |
|---|---|
| Equipment list | No catalogue data available for units 01/02/03. Locations of indoor and outdoor components as noted above. |
| Temperature control | Units 01/02/03:<br>Temperature control included in unit controllers and hand held remote controllers. |
| Time control | Units 01/02/03:<br>Time control included in unit controllers. No timer set – units operate on temperature control. |
| Maintenance regime | Units 01/02/03:<br>Records include reports of 3-monthly maintenance visits.<br>Filters recently hovered by on site maintenance staff following 6 monthly inspections. No reports of refrigerant leakage. |
| Controls and sensors | Units 01/02/03:<br>Controls integral to units and included in routine maintenance.<br>Sensors in unit, wall mounted. Capacity control by variable speed compressor. |
| Metering | Units 01/02/03:<br>None |
| Loads | Units 01/02/03:<br>No record of design loads |
| Issues | Units 01/02/03:<br>None |

| Inspection of equipment: system documentation | |
|---|---|
| Checklist reference | Observations and advice |
| PS1.1 Plant location | Units 01/02/03:<br>Located as described. |
| PS1.2 Maintenance regime | For clarity, maintenance engineer should be asked to state on future records when leakage testing and other observations have been made, even where the results are negative. |
| PS1.3 Plant size in relation to cooling load | Unit 01: Level 5 Patch Room approx 24m². Approximate cooling load (BSRIA Rule of Thumb for IT rack rooms): 400 W/m² x 24 m² = 9.6 kW. Installed size = 4.5 kW. Given there are 2 identical packaged systems serving the room, the unknown equipment heat loads and the lack of end user complaints, the sizing of unit 01 is considered appropriate to present load.<br><br>Unit 02: Level 6 Patch Room approx 24m². Approximate cooling load (BSRIA Rule of Thumb for IT rack rooms): 400 W/m² x 24 m² = 9.6 kW. Installed size = 5.0 kW. Given there are 2 identical packaged systems serving the room, the unknown equipment heat loads and the lack of end user complaints, the sizing of unit 02 is considered appropriate to present load.<br><br>Unit 03: Level 3 Security Room approx 29m². Approximate cooling load (BSRIA Rule of Thumb for IT rack rooms): 400 W/m² x 29 m² = 11.6 kW. Installed size = 10 kW. Given there are 2 identical packaged systems serving the room, the unknown security equipment heat loads and the lack of end user complaints, the sizing of unit 03 is considered appropriate to present load. |
| PS1.4 Usage / metering | No metering or records: Consider installing hours run or energy meters to monitor use of systems. |
| PS1.5 Proximity to heat sources | Units 01/02/03:<br>No heat sources located near outdoor units. |

| Inspection of equipment: outdoor and indoor units | |
|---|---|
| Checklist reference | Observations and advice |
| PS2.1 Usage / metering | No metering or records: Consider installing hours run or energy meters to monitor use of systems. |
| PS2.2 Outdoor units | Plant located as described. |
| PS2.3 Signs of leakage | Outdoor units are generally clear of traces of oil or other signs that might indicate leakage. |
| PS2.4 Operation | No issues with operation. |
| PS2.5 Obstructions to airflow: | Units 01/02/03:<br>No obstructions observed. |

| Inspection of equipment: system controls | |
|---|---|
| Checklist reference | Observations and advice |
| PS3.1 Zoning | Units 01/02/03:<br>Not applicable all units serve single zones. |
| PS3.2 Control time setting | Units 01/02/03:<br>Not applicable. Units on fully manual control. |
| PS3.3 Control periods | Units 01/02/03:<br>Not applicable. Units on fully manual control. |
| PS3.4 Control sensors | Units 01/02/03:<br>Remote sensors appropriately placed on wall. |
| PS3.5 Set temperatures | Units 01/02:<br>All units set to 19°C. Suggest these could be reset to 22°C or higher. This will reduce energy consumption while units are operating and reduce operating periods.<br><br>Unit 03:<br>Unit set to 24°C |
| PS3.6 Opening windows | Building sealed and fully cooled. Not applicable. |
| PS3.7 Equipment age and method of capacity control | Units 01/02/03 are approx. 8 years old and use variable speed compressors providing efficient capacity control. |

| Summary of advice | |
|---|---|
| Checklist reference | Observations and advice |
| PS1.2 Maintenance regime | For clarity, maintenance engineer should be asked to state on future records when leakage testing and other observations have been made, even where the results are negative. |
| PS1.3 Sizing | When replacement becomes necessary, consider smaller capacity units if IT rack/security equipment is been replaced with low energy versions. |
| PS1.4 Usage/metering | Consider installing hours run or energy meters to monitor use of systems. |
| PS3.5 Set temperatures | Consider resetting control for units 01/02 to 22°C or higher. |

| General observations and advice for load reduction or alternatives |
|---|
| None. |