THE BRITISH MUSEUM

BUILDING & ESTATES DEPARTMENT

Planning & Project Management Section

MECHANICAL SERVICES

HARMONISATION DOCUMENT

Issue	Revision	Date	Changed
-	0	05.10.99	First draft
1st	1	15.06.2000	
2nd	0	15.08.2002	

Prepared by			Quality Assured by			Approved by		
Date	Name	Initials	Date	Name	Initials	Date	Name	Initials
15.08.2002	Karlekar		16.08.2002	J ones		22.08.2002	Gofton	

CHANGES SINCE LAST ISSUE

- Use of floor void for distribution of ventilation system to be avoided.
- Use of Actionair Panel in each sector to monitor and control Fire/Smoke Dampers
- Installation of new equipment using Refrigerants R11, 12 and R22 not allowed.
- LWF's comments on fire safety and fireman's control for ventilation plant incorporated.
- Conservation's comments on use of environmentally controlled display cases incorporated.
- Permanent operation of Energy Centre boilers at 90C confirmed.
- Attention drawn to old Boiler House being operated at 90C on trial basis.
- List of available and intended Mechanical Infrastructure documentation added in App. I.

FEEDBACK SHEET

Feedback is welcomed and your views are sought; the sheet below will log all feedback received which will be included in the next update.

FEEDBACK RECEIVED	DATE	ANSWERS ACTIONS
Comments from LWF	01.02.02	Now incorporated
Fire Damper study by Klimaat	01.02.02	Recommendations incorporated
Comments from Conservation	01.02.02	Now incorporated
Current refrigerant Regulations	01.02.02	Now incorporated
Add a list of all reports produced for Mechanical Services at the BM + collate a copy of each for reference	01.02.02	Now incorporated
Revise to take account of new Building & Estates Department	01.08.02	Will do in the next update
Other items will be added as received; please send your feedback to BMD - P&PM Section		

CONTENTS

1.0 PREAMBLE

1.1 Background

Since the BMD/P&PM Section was formed the team have had concerns with regard to the ad-hoc manner in which the replacement/upgrade/development of the site infrastructure had been approached.

Consequently site-wide sketch designs were, and are being, developed to cover most aspects of infrastructure in order to establish an overall plan (›design‹), to which all projects would be harmonised in order to reach a common goal. This ›Harmonisation‹ would be achieved through the publication of a series of documents, each dealing with a specific element of infrastructure.

Thus, not only would the infrastructure specific projects have a set standard, but so also would those elements of infrastructure being provided as part of the projects of others.

In addition, where there are other commonalities between projects, e.g. documentation, procedures etc. Harmonisation documents should be developed to ensure a common approach.

This Document is one of a series of publications to be issued, and be updated annually, by BMD P&PM, for use by Project Design Teams.

- Building Management System Strategy *Issued 8/1999*
- Electrical Infrastructure (EI) Harmonisation *Issued 07/2001*
- Mechanical Infrastructure Harmonisation *Issued 07/23001*
- Intruder Detection System Harmonisation *Issued 10/2000*
- Fire Alarms and Emergency Lighting Harmonisation *Issued 10/2000*
- Fire Precautions (Building) Harmonisation *Issued 6/2001*
- Fire Precautions (Mechanical) Harmonisation *Issued 03/2001*
- Lifts Harmonisation *Y2K draft 07/2001*
- Museum (BMD) CAD Strategy. *Issued 03/2002*
- CDM Regs Harmonisation *Issued 01/2001*
- Procurement Strategy *In preparation*

- Site Works Procedures Harmonisation *Issued 6/2000*
- Building Harmonisation *In preparation*
- Lightning Protection Harmonisation *In preparation*

Documents published by The British Museum Design Office (BMDO) for the guidance of project teams include:-

$ Gallery Lighting Control

$ Illuminated Escape Signs Specification

$ Aesthetic considerations and Equipment in Galleries.

A Document to be published by Building Development & Planning/Architecture Project Management and Planning (BDP/APMP) for the guidance of project teams is: -

$ The British Museum Conservation Plan.

Arrangements to refer to the above documents should be made through the BMD/P&PM project representative, or through BMDO & APMP project representatives direct where represented on the project team.

The project designer(s) retains full design responsibility; where the content of any Museum guidance document causes the designer concern over this responsibility it should be brought to the attention of the Project Manager.

1.2 Roles and Responsibilities

A number of positions are referred to within this document. The roles and responsibilities of each are summarized below:

1.2.1 All projects

BM Project Manager	The named officer responsible for the planning and implementation of the project.

BMD Project Planner	Responsible for being a member of the project teams led by others, providing assistance and setting BMD required standards.
System Coordinator (currently Vasant Karlekar)	Will act as a 'Focal point' for all projects System coordinators role:

Setting Standards

1. Procedures
2. Incorporating new products/methods

Providing adequate Technical Information/Advice

3. Site Wide designs
4. System documentation
5. Circulate technical press clippings

Providing Coordination

6. Receive advice on all projects and maintenance works affecting mechanical services.
7. Publicize System information.
8. Stakeholders for all work related to mechanical services
9. Maintain mechanical services drawings.

Planning for the future

10. Capital Programme

The system coordinator will not be obstructive; if advice cannot be provided within the required time frame the project manager has the right to proceed alone (unless advised of an overriding circumstance).

BMD Maintenance& Works Manager	Responsible for operation & maintenance of all existing buildings & engineering services within the British Museum
BM staff & Project Consultants	Responsible for the design and supervision of all building & engineering services associated with the particular project, complying with the guidance documents, or liaise, via the Project planner, with the specific System Coordinator to fully determine the requirements of the British Museum.
Assurance Consultants	Assurance Consultant Team comprising (as appropriate) • Building Assurance Consultant • M&E Engineering Assurance Consultant • Cost Assurance Consultant (QS) • Fire Alarm Assurance Consultant The discipline with the major involvement will also be appointed Lead Assurance Consultant, Planning Supervisor (and Cost Assurance consultant on projects which do not merit a QS). This consultant also acts as pre-order (to contractor) Project Manager & Designer and post order (to contractor) employers monitor. The Assurance team develop the delivery Package which includes the GC/Works 5 Stage 2 deliverables (RIBA Stage D) together with other constraints/conditions deemed applicable by the consultant team and BM.
MTC	The Contractor carries out the duties of the post order Project Manager, Designer & Constructor. He completes the design to working drawing stage, develops the programme, prepares his lump sum costing based on his tendered Measured Term Contract rates and includes all into the Execution Package for the project. On approval of the Execution Package by the Project Planner, him received Assurance that it is Technically correct by the Assurance Team, the contractor proceeds to construct.

BMD Site Works Representative	Responsible for ensuring works are carried out in accordance with the Contract Documentation. For details of duties refer to Site Works Procedure Harmonisation Document.

1.3 Sector Autonomy

The Museum is subject to the Fire Precautions (Workplace) (Amendment) Regulations 1999 and as such has a strict Fire Risk assessment policy. Any works planned to the Mechanical services and systems should be referred in the first instance to the System Coordinator for consideration of the need for consultation with the Head of Security/Fire Safety Manager.

The Bloomsbury site is sub-divided into 7 autonomous building Sectors, each being separated by fire barriers having 4 hour fire integrity, as shown in principle on drawing no. Z000121.

Each Sector is to be regarded as far as practical as an autonomous building for servicing purposes. Services will not normally cross boundaries from one Sector to another except at the highest level of distribution to carry the source of the service into the Sector, e.g. Primary Network, Site Distribution Mains etc.

Where it is proposed to cross the Sector boundary at a lower level of distribution the matter must be agreed by the System Coordinator, who will refer to the Fire Safety Advisor, amongst others.

Sector boundaries are defined in the Museum (BMD) CAD strategy. Some boundaries differ slightly on different levels of the building. Any changes to Sector boundaries will only be made with the agreement of Building Management Department and The Fire Safety Adviser, and will be reflected by a change in the CAD Strategy master background drawings.

1.4 INTRODUCTION

The purpose of the Mechanical Services Harmonisation Document is to provide strategic and general guidance for the designers of specific projects throughout the Museum.

Although the detailed requirements for a specific project will be determined by the project design team, the strategy outlined in this document should be followed to ensure that all projects take into account the long term development plans for the mechanical services in the Museum and also uniformity of installation.

Projects which need to be served initially by the existing infrastructure should be designed in such a manner that they can eventually be served by the infrastructure arrangements outlined in this document with minimal alteration to work which has been carried out.

This Document will be kept under review and developed as the need arises.

Any deviations from the principles given in this document should be agreed with the BMD/P&PM.

The Document is arranged in the following sections:-

Section 1 - Introduction
Section 2 - General Requirements
Section 3 - Environmental Design Conditions
Section 4 - Existing Systems and Future Strategy

The section on general points covers matters which apply to more than one aspect of the mechanical services.

The total cost of running the services is of major importance and should be kept to a minimum. Although energy is likely to be the major factor in operational costs, maintenance and equipment replacement costs will also be significant and any measures to reduce energy consumption should also take into account fully the maintenance aspects involved.

Complex energy saving measures which call for the operating and maintenance staff to have a high level of design knowledge in order to obtain the full benefit of the measures should be viewed with caution and agreed with the BMD/P&PM before being designed or implemented.

The designers of a new project should make themselves aware (via BMD Project Managers) of other projects being undertaken and should seek and suggest ways of taking advantage of the other projects to assist harmonisation of the services.

2.0 GENERAL REQUIREMENTS

This Section covers general points which apply to more than one aspect of the mechanical services.

2.1 Standard Technical Specifications and Reference Documents

2.1.1 Standard Technical Specifications

The materials and plant used on all installations should generally comply with the latest versions of the Standards listed below which were previously published by the PSA:-

M&E 1 Electrical Services for Buildings
M&E 3 Heating, Hot and Cold Water, Steam and Gas Installation for Buildings
M&E 100 Air Conditioning, Air Cooling and Mechanical Ventilation for Buildings.

As an alternative to the ex-PSA Standards, Defence Estate Organisation Specifications 036, 037 and Guide 08 may be used.

2.1.2 Reference Documents

The latest editions of the following Museum Reference Documents should be taken into account in the development of the mechanical services. All documents may be accessed by arrangement with BMD/P&PM.

- Documents listed in Section 1.0
- Documents in Appendix I
- Final Sketch Design

  - Sector A - East Wing
  - Sector B - South Wing Phase II
  - Sector C - South Wing
  - Sector D - West Wing
  - Sector E - Inner North Wing
  - Sector F - King Edward VII Building

- Specification - Firefighting Water Supplies
- Firefighting Hosereel Installation Report
- Fixed Fire Suppression Systems Report
- Fire Stopping Supplement

Other reference documents will be issued from time to time by the BMD/P&PM.

2.2 Drawings

2.2.1 CAD Strategy

All drawings should conform to the BMD CAD Strategy Document including title blocks and drawing numbering.

2.2.2 Layout Drawings

General layout drawings, excluding plant rooms may be produced at any standard scale suitable for the particular purpose.

Plant room layout drawings should be at 1 : 50 scale or 1 : 20 scale unless particular considerations apply.

Sections and details should be drawn to a suitable scale to adequately illustrate the services requirements.

The preferred drawing size for layout drawings is A1. AO size drawings should not be produced unless there is a compelling reason.

Layout drawings should show the 12.5m grid, new room numbers, sector boundaries and the match lines between drawings. Cross reference should be made to associated and continuation drawings.

All mechanical services plant including associated switchgear, motor control centres and electrical equipment shown on the layout drawings should be identified with their system reference.

All ductwork should be shown on the layout drawings by a two line plan view with the width shown to scale. Sections should be drawn to show the relationship of the ductwork to the building and to other services. Clearances from the floors, wall and equipment should be shown in critical locations.

Pipework on 1 : 100 scale layouts should be shown single line. Pipework in plant rooms may be shown in single or double line depending on the complexity of the layout.

The space requirements for maintenance access in critical locations should be shown on the layout drawings. With the exception of minor items which require infrequent attention all equipment should be able to be maintained from floor level or from fixed access platforms. The access platforms should be shown on the layout drawings.

2.2.3 Flow Diagrams

Flow diagrams of pipework circuits and air distribution systems should be produced for each project. The diagrams should show all major components together with all manual and motorised valves and all motorised dampers.

Where appropriate the diagrams for air distribution systems should show manual regulating dampers and fire dampers but care should be exercised to avoid over complicating the diagrams and distracting from their main purpose which is to convey a clear understanding of the design

principles.

The location, level and grid reference of each major plant item should be stated on the flow diagrams.

2.2.4 Design Standards and Calculations

All systems should be designed in accordance with CIBSE recommendations and British Standards Specifications stated therein.

The Consultant/Designer must carry out detailed methodical calculations of Heat loss, Heat gains, Psychometric Analysis, Pressure Drops, Pipe Sizing, Duct Sizing, Flow rates, Part L compliance, etc.

As a routine, a copy of all detailed calculations, in form without the need for software, shall be submitted to the BMD/P&PM including Part L compliance calculations.

2.3 Equipment

2.3.1 Standardisation

It is the intention of the BMD/P&PM to produce a list of preferred manufacturers for the equipment and components used in mechanical services installations. Wherever possible the list will provide alternative manufacturers for each item of equipment.

An initial list of preferred manufacturers is given in Appendix B. The list will be extended progressively. Equipment supply of "equal and approved" manufacture must always be allowed for in Specifications.

Where preferred manufacturers have not been selected the designer should submit a list of proposed equipment manufacturers to the BMD/P&PM for agreement.

All plant items should incorporate facilities to enable the equipment to be monitored by Museum's Trend BMS. To assess any need for cooling for internal rooms, without natural ventilation, summer time temperature calculations shall be carried out and a copy submitted to BMD P&PM, before any decision is taken for provision of cooling.

2.3.2 Re-Use of Existing Equipment

Existing equipment should not be re-used unless:-

- The equipment fully meets the harmonisation standards
- There is a clear economic advantage in its re-use.

2.4 Standby Plant

In general, standby air handling units are not required, but for galleries and areas where conditions are critical, consideration should be given to sharing the total load between two or more air handling systems.

Toilet extract systems should have duty and standby fans.

Duty and standby pumps should be provided for all applications except for minor HWS secondary circuits when a single pump will be acceptable. Twin headed pumps may be used where appropriate.

Standby refrigeration equipment is generally not required except for critical areas which shall be specifically agreed with the BMD/P&PM. Wherever it is practicably possible without incurring a high cost penalty the total cooling load for any area should be shared between two or more refrigeration plants. Where a single refrigeration plant is used it should, where practicably possible, have two or more compressors and independent refrigeration circuits to provide a measure of standby.

All duty and standby plant items should be arranged so that both units run for an equal amount of time. With the exception of smoke extract fans, mechanical services plant should not be connected to the emergency power supply system.

Standby requirements should be agreed for each project and shown on the Room Data Sheets.

2.5 Protective Measures

Failure of the mechanical services can cause serious damage to the artefacts and the building and the designer should pay careful attention to minimising the risks of failures. Particular attention should be paid to the following aspects:-

- Frost protection of external pipework including trace heating of chilled water and cold water services. Use of non toxic and non corrosive Glycol may be considered for chilled water.

- Measures to prevent the heating systems and pipework services within the building from freezing.

- Wherever possible water pipework should not be run above galleries or sensitive storage areas. Where it is not possible to adhere to this principle the water pipe should be enclosed by a second pipe or should have a drainage channel under the pipe. The drainage/pipe channels should have capped ends and drainpipes should discharge into areas where the discharge will be clearly visible

  Each drainage pipe/channel should be fitted with a leakage detector to provide an alarm if leakage occurs and to identify the location of the leak

  The extent of pipework which requires leakage protection should be agreed with the Museum and shown on the Room Data Sheets referred to in Section 3 of this document.

- If sprinklers are activated water may damage areas which are not affected by the fire, particularly those rooms which are directly below the area where the fire occurs. Wherever it is practicable precautions should be taken (e.g. sealing service holes, providing upstands around builders work openings etc.) to minimise water damage outside the area where the sprinklers are activated

- Alarm conditions should be activated when environmental conditions in critical areas exceed the pre-set limits. The alarm requirements should be defined for each project and shown on the Room Data Sheets. In general a two stage alarm is preferred. The first stage should indicate that conditions are outside the design limits so that corrective action can be initiated. If conditions continue to deteriorate the second stage alarm should shut down the air conditioning system to minimise the risk of conditions becoming increasingly worse as a result of control malfunction. Provision should be included to enable air conditioning plants to re-started manually before conditions have returned to normal

- Operating and Maintenance Manuals should explain the functions of all protective and alarm systems and shall also give the procedures to be followed by both technical and non-technical staff when an alarm is activated

2.6 Identification of Pipework and Ductwork

Pipework should be colour coded and labelled in accordance with relevant BS. Ductwork should be colour coded and labelled in accordance with HVAC Specification DW 144.

2.7 Solar Heat Gain

Consideration should be given on all projects with windows and/or roof lights to reducing solar heat gain by suitable shading or solar control glass.

Where practicable shading should be adjustable to enable maximum benefit to be gained from natural light when the sun is not shining on the glass.

If solar control glass or film is used the colour rendering and UV characteristics should be considered and agreed with the BMD/P&PM.

2.8 Services Accommodation

Designers should identify all services accommodation required for a project (e.g. plant rooms, roof space, trenches risers etc.).

In some cases three different locations will need to be identified namely existing accommodation, transitional accommodation and final accommodation.

Designers should schedule the accommodation required so that the Museum can agree the availability of the space. The schedule should give the room number of the space and should state whether the space is existing, transitional or final.

2.9 Areas Adjacent to a Specific Project

The Museum funding arrangements often makes it necessary to undertake projects involving a smaller isolated area of the Museum.

In order to facilitate the future development of the areas surrounding a specific project, consideration should be given to the long term development of the services infrastructure. Provision should be made where appropriate to cater for planned future developments.

Wherever possible provision for future developments should be limited to aspects which do not increase the cost of the specific project. Particular examples are:

- Space allocation for future services
- Routing of services to allow for long term development plans
- Sizing of services to take into account future developments which are likely to proceed in the relatively near future
- Arranging the services to suit the harmonisation requirements of the infrastructure.

Where provision for future developments is likely to involve an increase in the cost of a project, the matter should be referred to the BMD/P&PM for a decision.

The adverse affects of a project on adjacent rooms should be taken into account and proposals should be prepared for mitigating the adverse affects. For example a project may affect the natural ventilation or noise level in adjacent rooms.

2.10 Value Engineering and Life Cycle Costing

In order that the Museum can achieve the best value for money value engineering and life cycle costing should be carried out for a new project taking into account capital energy and maintenance costs and the cost of plant replacement.

The criteria for life cycle costing should be agreed with the Museum at the start of a project.

2.11 Energy Targets

Museum has received Energy Efficiency Accreditation and as an aid to minimising energy costs the BMD/P&PM envisages setting energy targets for new projects. To assist in establishing the energy targets the predicted energy consumption for mechanical and electrical services in a new project should be calculated to give a figure of kWh/m5/year for the main types of accommodation.

To provide an initial guide for comparative purposes the following average energy consumption figures have been taken from the Energy Consumption Guide and Energy Efficiency in Buildings published by the Department of the Environment.

	kWh/m5/year
Museum/Art Gallery	265
Sales Areas	280-390
Offices - Naturally Ventilated	130-160
Offices - Standard Air Conditioned	240

2.12 Services Demands for New Projects

The following information on the overall services demands for each project shall be shown on the flow diagrams and on a load schedule in the operating and maintenance manuals. A copy of this shall be submitted to the System Coordinator at the Design Stage.

!	Heating load	kW
!	Primary MTHW/LTHW flow rate If a project is initially required to operate with MTHW the future LTHW flow rate shall also be stated	litres/sec
!	Cooling load	kW
!	Chilled water flow and return temperatures	°C
!	Chilled water flow rate	litre/sec
!	MCW peak flow rate	litre/sec
!	CWDS storage volume	litres
!	CWDS peak flow rate	litres/sec
!	HWS storage volume	litres
!	HWS peak flow rate	litres/sec
!	Power requirement for mechanical services plant	kW
!	Standby power requirement for mechanical service plant	kW

2.13 English Heritage

English Heritage will need to be consulted on all aesthetic matters and matters affecting the fabric of the building which is a listed Grade 1 structure. Contact with English Heritage and with the London Borough of Camden should be through the Project Manager. See Appendix H for English Heritage/Camden liaison procedure.

2.14 Bearing Currents

Designer's attention is drawn to this phenomenon which causes premature failure of bearings due to currents induced in the motor shaft and discharged to earth through bearings. Electrical cabling to such drives should be appropriately designed.

3.0 ENVIRONMENTAL DESIGN CONDITIONS

3.1 General

At the start of each project a Room Data Sheet is to be prepared for each room in the project to define the Environmental Design Conditions required and to provide other related information.

The Room Data Sheets should be prepared by the Design Team and approved by the BMD P&PM as the basis for the design of the mechanical services.

Should the development of a project require changes to the information given in the Room Data Sheets the Design Team should obtain approval from the BMD P&PM for the proposed changes. The full implications of any changes whether generated by the Museum or the Design Team should be evaluated before a change is accepted.

A typical Room Data Sheet is given in Appendix D.

3.2 External Design Conditions

Winter Outside Design Temperatures for Heat Loss Calculations

Rooms where heating is required during daytime only (eg offices)	- 3°C dry bulb	- 3°C wet bulb
Rooms where full heating is required continuously (eg critical galleries and storage areas governed by conservation requirements)	- 4.5°C dry bulb	- 4.5°C wet bulb

Winter Outside Design Temperature for Trace Heating and Anti-Frost Air Heating Coils

Trace heating	- 15°C
Anti-frost air heating coils for plants which operate during daytime only	- 10°C
Anti-frost air heating coils for plants which operate during the night	- 15°C

Note: See Clause 4.2 for further information on the application of anti-frost air heating coils

Summer Outside Design Temperatures

Rooms requiring comfort cooling	28°C dry bulb	20° wet bulb
Rooms where conditions are determined by the artefacts or conservation requirements	30°C dry bulb	21° wet bulb
Inlet air to air cooled condensers and condenser water coolers	35°C dry bulb	

Background Noise Levels at the Site Boundary

The site boundary for the purpose of defining background noise levels is shown on Drawing M000026.

Daytime background noise levels at the site boundary	North Boundary	46	dBA
	South Boundary	55	dBA
	East Boundary	47	dBA
	West Boundary	47	dBA
Night-time background noise levels at the site boundary	North Boundary	37	dBA
	South Boundary	39	dBA
	East Boundary	33	dBA
	West Boundary	40	dBA

The purpose of defining the background noise level at the site boundary is to enable the installations to be designed which do not cause disturbance to adjacent properties.

The noise level from new plant should be 5 dBA below the existing ambient noise level at one metre from the nearest habitable room.

Background Noise Level within the Site Boundary

Background noise level for general applications	LAeq 76	dBA
	LA90 66	dBA

The purpose of defining the background noise level within the site boundary is to enable external sound to be attenuated to achieve the required internal sound levels.

Background Noise Levels for Sensitive Projects

For some projects, background sound levels may be particularly sensitive. Examples are:-

- Projects where equipment is required to run at night close to noise sensitive buildings such as hotels with opening windows and other buildings on the perimeter of the site which are not occupied by the Museum

- Projects where fresh air inlets are required to be installed close to a high noise source which is above the general background level of 66 dBA

For sensitive applications a local noise survey may be required. If the Design Team consider that a noise survey is required they shall obtain the BMD P&PM's agreement before proceeding.

If the Local Authority stipulates noise levels which are more stringent than the noise levels given in this document, the Local Authority requirements shall take precedence.

3.3 Internal Design Conditions

General Policy

Wherever possible rooms should be served by simple heating and natural ventilation to minimise capital and running costs.

Where natural ventilation cannot be provided or is unsuitable, mechanical ventilation is the preferred option.

Comfort cooling should only be considered when natural or mechanical ventilation will not provide tolerable environmental conditions.

Air conditioning should only be provided where full control of environmental conditions is essential to safeguard artefacts or to ensure the satisfactory operation of sensitive equipment.

If a project requires comfort cooling or air conditioning the Design Team must consider the full consequences of the requirement (eg cost, space, increased power, effect on the services infrastructure etc).

The environmental conditions required for a specific project should be decided by the Design Team and agreed with the BMD P&PM at the very outset.

4.0 EXISTING SYSTEMS AND FUTURE STRATEGY

4.1 Air handling systems

4.1 .1 General Principles

Fresh Air Supply for Occupants

The fresh air volume for each room should be based on the maximum number of occupants shown on the Room Data Sheets. Where it is probable that there will be a significant number of occasions when the room will not be fully occupied provision should be included to enable the fresh air volume to be reduced to suit the number of occupants in order to minimise energy consumption during severe weather. The method of reducing the fresh air volume should be determined by the Designer.

Fresh Air for Free Cooling

Where possible fresh air should be used to provide free cooling during the winter and mid-seasons for areas which require comfort cooling or air conditioning.

Night Time Cooling

Consideration should be given to ventilating the building at night during the summer to remove heat from the structure and fabric and thereby reduce the cooling load on chiller plant.

Nighttime ventilation should not reduce building security. Precautions should be included to prevent the ingress of rain or strong winds which could damage the building.

Ductwork

Wherever possible ductwork systems shall be of the low velocity type to minimise fan power consumption.

Systems should be designed so that all ductwork can be thoroughly cleaned internally to satisfy Health and Safety Requirements. Designers shall comply with the Guidance on the Cleanliness of New Ductwork Installations and the Cleanliness of Ventilation Systems published by the HVCA/publication ref TR/17 and CIBSE publication ref.TR 99.

Displacement Ventilation

Mechanical ventilation or comfort cooling systems for galleries should be designed, where possible, for displacement ventilation where the supply air is delivered at low velocity at or near floor level. Displacement ventilation may not be suitable for rooms where temperature stratification could damage artefacts.

To minimise running costs the supply air should generally not be cooled except where specifically agreed by the BMD P&PM and shown on the Room Data Sheets.

Exhaust Air Discharge Points

The location of exhaust discharge points for toilets, kitchens and smoke exhaust should be given careful consideration to ensure that the discharged air cannot re-enter the building or be trapped in a restricted area.

Floor Voids

Use of floor void for distribution of ventilation system should be avoided. Only inert services not likely to spread fire should be considered for installation in floor voids.

Future Developments

Where an area to be refurbished is adjacent to other areas which are due for refurbishment in the near future consideration should be given to allocating space for future air handling equipment or providing air handling units and ductwork of sufficient capacity to serve the adjacent areas. Care should be taken to ensure that the air handling systems which are sized to cater to future developments can operate satisfactorily at reduced capacity initially.

4.1.2 Air Handling Units

General

Air handling unit should conform to Specification M&E 100.

Careful attention should be given to weatherproof units which are installed on the roof. Particular consideration should be given to protecting control valves, actuators, sensors and electrical equipment. Where possible a local housing should be used to cover the AHU and associated equipment.

Other specific points relating to air handling units which may not be covered by M&E 100 are given below.

Anti-Frost Heating Coils or Electric Heater Batteries

Anti-frost heating coils or electric heater batteries should be provided on all plants with 100% fresh air during the winter to prevent filters from freezing and to give protection to heating and cooling coils.

Anti-frost heating coils or batteries should also be provided on plants where the proportion of fresh air to recirculated air handled during the winter is sufficiently high to cause the mixed air temperature to be below freezing during severe weather.

Anti-frost coils or batteries are not required on plants where the proportion of recirculated air is sufficiently high to ensure that the mixed air temperature will be above freezing during severe winter weather.

Anti-frost heaters should be designed to raise the fresh air temperature from the external temperature given in Clause 3.2 (-10 or -15°C depending on the application) to a minimum of + 3°C.

The controls for anti-frost coils/batteries should include an interlock to stop the supply fan should the temperature of the air leaving the coil/battery fall below + 2°C.

Because anti-frost heating coils or batteries will be fitted before the air filters the coils or batteries should be designed for easy cleaning.

Air Filtration

Dust filters shall be provided on supply air systems to give the air filtration standards stated in the Room Data Sheets.

In general two stage throw-away fabric filters should be used. In general, the first stage filters should provide basic filtration (EU3 standard) to increase the life of the second stage filters (EU6 standard) which will provide fine filtration to give the standard required.

Recent investigations have shown that the quality of the air in the Museum is such that activated carbon filters are unlikely to be required to reduce the level of SO_2 and other atmospheric pollutants. However to cater for a possible deterioration in air quality, consideration should be given to providing a spare section in the air handling units serving galleries and storage areas which are governed by conservation considerations to allow activated carbon filters to be installed in the future.

The air handling units which require space to be left for activated carbon filters should be agreed with BMD P&PM .

In a small number of air handling systems the BMD P&PM may require activated carbon filters to be installed initially, to protect artefacts where short term exposure to atmosphere pollutants would be harmful. Where activated carbon filters are required initially the fresh air quantity should generally be kept to the minimum required to serve the number of occupants. Fresh air should generally not be used to provide free cooling which could reduce the useful life of the activated carbon filters unless it can be demonstrated that the savings from free cooling will exceed the cost of activated carbon filters.

4.1.3 Variable Speed Fans

Consideration should be given to using variable speed fans where the air distribution system can perform acceptably with a reduced air volume.

In each case where variable speed fans are proposed a financial justification should be submitted to the BMD P&PM to show that the cost of the speed controls will be justified by the energy savings which will be achieved.

Variable speed fans may also be helpful in reducing fan noise where plants are required to operate at night.

4.1.4 Motorised Dampers

A motorised damper should be fitted to the fresh air inlet to each supply air plant and to the discharge from each extract system to prevent air leaving the building by stack effect when the fans are off.

Motorised dampers should be provided on recirculation ducts when there is a requirement to vary the proportion of fresh air and recirculated air to provide free cooling or to suit the number of occupants.

4.1.5 Heat Recovery

Heat recovery systems should be considered where they are economically justified and feasible.

Before proceeding with the detailed design of a heat recovery system, an economic justification should be provided for consideration by the BMD P&PM . The justification should give the costs of the energy saving equipment together with the anticipated payback period. The calculations should also include additional power costs from the introduction of the heat recovery equipment and for any additional maintenance that may be required to ensure that the heat recovery units are able to operate at peak efficiency.

4.1.6 Environmentally Controlled Display Cases

Environmentally controlled display cases can offer considerable benefits by reducing or avoiding the need to air condition entire galleries to close tolerances in order to provide acceptable conditions for sensitive artefacts such as those displayed in the Ethnography Galleries.

The practicality and economics of using environmentally controlled display cases should be evaluated by the project team on project specific basis.

When considering the use of environmentally controlled display cases it should be borne in mind that conditions in the gallery can effect the duty and complexity of the display case environmental systems. In general display case environmental system can pressurise the cases with filtered air and provide basic humidity control at a relatively modest cost. Costs are likely to increase significantly if the temperature in the display cases also needs to be controlled within close tolerances, particularly if conditions in the gallery can vary widely. In some instances it may be desirable and cost effective to provide a limited amount of air cooling and humidity control for a gallery in order to limit the capacity and complexity of the display case environmental systems.

Whilst the display cases may be procured under a separate contract, the project team should contribute to their design so that the cases include all equipment needed to ensure BMDO who are responsible for the cases are satisfied.

Maintainability of the display case environmental systems is important and all equipment should be arranged so that there is good access.

4.1.7 Smoke Extract Ventilation and Smoke Dampers

The requirements for smoke extract ventilation on each project should be discussed with Fire Safety Advisor.

In all cases where ventilation ductwork is installed or adapted it must be ensured that a combined fusible link and electrically operated opposed blade smoke and fire damper (example: Actionair smoke/shield) is installed on all lines of structural compartmentation to provide fire resistance at least to the standard required of the building element penetrated.

The general principle for the installation and commissioning of all combined dampers is defined as:

i) All dampers installed in construction that is adjacent to or may have an effect on means of escape from the building must be combined dampers installed to activate on smoke detection. The status of the damper is to be monitored. Damper units to be operated by the local fire alarm zone AFD where available. If local room space automatic detection is not available, AFD must be installed, duct mounted to detect smoke in the ducktwork either side of the compartment structure.

ii) All dampers installed in construction not affected by adjacent means of escape must be combined dampers installed to activate on heat (fusible link) operation. The status of the damper is to be monitored.

The regime for fire alarm interface, damper monitoring and re-set capability is to be agreed with the Museum=s Fire Consultant and Museum=s Project Officer. Power supplies to units to be 230 volt derived from local dedicated maintained circuit via an un switched fused connection unit. Operation of dampers will be controlled via Museum=s Fire Alarm Systems and Smoke Detectors.

The dampers will be wired back to Sectors Actionair Action pack panel via data network and interface units utilising graphic user interface. The system shall be also interfaced with the site BMS and Fireman's Panel. Where installation of Sector Panel cannot be justified on economic grounds, as a minimum, Actionairs SFDI's should be installed and wired to dampers. Power supply to dampers should be interfaced with Fire Alarm System via contactors.

The determination of means of escape and general requirement for smoke activation to dampers to be agreed with the British Museum Head of Security (Fire Safety Manager) or the Fire Safety Advisor to the Museum.

Project teams are to review each project/installation and propose any enhancement to these standards for approval by BMD P&PM. Consideration in this respect should be given to risk to Museum collections from smoke damage.

Designers must ensure that adequate space is allowed for future installation and maintenance of the equipment needed to upgrade dampers from heat to smoke activation.

Emergency Power Supplies to Fire Safety Installations

In every Sector there will be an emergency maintained distribution switchboard with supplies derived from the mains an emergency generator with automatic change over on failure of mains supply. Adjacent to each emergency maintained switchboard and supplied from it there will be a triple pole and neutral, 6 way secure supply distribution board. This is intended to supply small secure supplies to equipment such as dampers.

Dampers

All dampers should be specified to ›fail safe=. Emergency power supplies are not a requirement. Control panels for dampers to be powered from a secure supply distribution board. Power supplies to panels will be monitored by the BMS where available.

Smoke Control

Power supply to the mechanical extract system shall be via the sector emergency maintained distribution switchboard. Operation of the smoke control mechanical extract will be activated by local room space AFD. The cause and effect of operation to be defined by the Fire Safety Advisor. In the short/medium term the parameters of operational activation may vary from the long term condition dependent upon the availability of AFD system installation. All extract systems shall be linked to the fireman=s control panel with the potential to energise, de-energise or re-set the plant. Mechanical plant to be monitored locally at the mechanical plant control panel and centrally via the BMS where available.

On activation of fire alarm, ventilation plant serving that particular area shall automatically be shut down.

4.1.8 Humidifiers

Re-circulating type humidifiers shall be avoided, instead, ultrasonic humidifiers may be considered. Steam humidifiers are preferred where this is economic and practical.

4.1.9 Heating and Cooling Coils

Heating and Cooling Coils including those fitted in AHU=s shall be copper tubes aluminium fins.

4.1.10 Firemans Control

All Air Handling Systems should be linked to Firemans Control Panel capable of energising/de-energising either supply, Extract or both of each system.

4.2 HEATING SYSTEMS

4.2.1 Boiler Plants

It is planned that the Museum will ultimately be served by low temperature hot water supplied from two boiler plants. The old Boiler House which is some 30 years old in Sector F, was designed for MTHW at flow and return of 118C/90C, 6.5 barg. mainly serves Sectors A, partially D, E and F and the northern plant rooms of Great Court. The Energy Centre boilers installed at Substation D in 1996 mainly serve Sectors B, C, partially D and the southern plant rooms of the Great Court and operate at primary LTHW flow and return temperature of 90°C/75°C . Great Court plant rooms have heat exchangers to provide hydraulic de-coupling with secondary side operating at flow and return temperatures of 82°C/71°C respectively. Eventually, all sector heating plant rooms will have plate heat exchangers to provide hydraulic de-coupling.

The boiler primary LTHW systems will operate at 90°C flow and 75°C return under full load conditions. The operating pressure will be 4.5 bar.g. The secondary side will operate at 82°C flow and 71°C Return. The hydraulic de-coupling between boiler primary LTHW and secondary side LTHW will be via a plate heat exchanger.

It will be some years before the heating systems served by existing Boiler House in sector ›F‹ can be fully changed over to LTHW. At present, these boilers are operating at 90C on an experimental basis. Designers of new projects should consult the System Coordinator before finalising design.

4.2.2 Changeover Arrangements

The changeover period from the present arrangements using MTHW to the new arrangements using primary LTHW will extend over a long period. Any new projects which occur during the changeover period will need to allow for the final arrangements which are described in 4.2.9.

The action required for a new project will depend on the nature and timing of the project. The range of changeover arrangements are outlined below.

4.2.3 Diversions, Modifications and Remedial Work to MTHW Mains

Any work carried out on existing MTHW mains should consider whether the modified pipework will ultimately be required to operate on boiler primary LTHW.

Where new MTHW pipework will finally form part of the boiler primary LTHW system the pipework should be sized for the higher flow rate.

The principles of a typical diversion are shown in Figure H1.

4.2.4 Air Heating Coils Connected Initially to MTHW Systems

Wherever possible, new air heating coils should be served by constant temperature secondary LTHW. Where it is not practicable to serve a new air heating coil with LTHW initially it may be necessary to serve the coil temporarily with MTHW.

Coils served temporarily with MTHW should have a minimum of two independent heat exchanger rows. When operating on MTHW only one row should be used, and on conversion to LTHW the remaining row(s) should be connected.

New control valves for air heating coils which are required to operate initially on MTHW should be sized for MTHW. When a coil is converted to LTHW the valve body should be replaced or, where practicable, the internal parts should be changed. Wherever possible control valve actuators should be selected to operate with both MTHW and LTHW so that they may be transferred when control valves are changed.

New regulating valves and commissioning sets which are required to operate initially on MTHW shall be sized for MTHW. When the system is converted to LTHW the valves and commissioning sets should be replaced as necessary.

Isolating valves shall be pipeline size to avoid the need to change valves when the system converts to LTHW.

The principles of a typical air heating coil change are shown in Figure H1.

4.2.5 New Projects Connected Initially to the MTHW System

During the changeover period new projects may be undertaken which will need to be served initially by MTHW. These projects should be designed so that they are suitable for final connection to the primary LTHW system which will operate at 90°C F/75°C R.

The minimum requirements are:

- A Primary LTHW to secondary LTHW plate heat exchanger should be installed to serve all heating equipment including air heating coils. No heat emitters should be served directly by Primary LTHW. The heat exchanger will initially operate on Primary at MTHW but shall be suitable for ultimate operation on Primary at LTHW. (90°CF/75°CR)

- The LTHW circuit arrangements should be as described in 4.2.10.

The principles of a typical new project connected initially to MTHW are shown in Figure H2.

4.2.6 Relocation of Existing Calorifier Rooms

Should it be necessary to relocate a calorifier room during the changeover period, consideration should be given to arranging the new calorifier room so that circuits can ultimately be served directly by boiler primary LTHW/Secondary LTHW.

The main consideration is likely to be the provision of space for constant temperature LTHW secondary pumps to serve existing air heating coils which are at present supplied with MTHW but will ultimately be replaced with coils served by secondary LTHW.

Consideration should also be given to sizing the LTHW pipework in the new plant room to suit the final arrangements.

The principles of relocating an existing calorifier room is shown in Figure H3.

4.2.7 Protection of Artefacts

Before shutting down any section of the MTHW or LTHW heating systems consideration should be given to the affect which the non-availability of heating may have on the artefacts. The shutdown arrangements should be agreed with the BMD P&PM and the Notification of Works procedures should be followed.

4.2.8 Safety

Large sections of the existing MTHW system, including the central boiler house are in excess of thirty years old. It is essential therefore that strict safety procedures must be followed when working on this system.

Before commencing any work which involves the shut down, draining down, connecting into, refilling, or testing of the system, a detailed method statement and itemised programme of work must be produced and agreed with the BMD P&PM. A Permit-to-Work must be obtained before any work is carried out on the MTHW system. Existing safety requirements for the MTHW system such as the requirement for double isolating valves shall generally continue to be followed until the systems are converted to LTHW, unless a waiver is specifically agreed by the BMD P&PM.

4.2.9 New Heating Arrangements

The principles outlined in this clause are intended to ensure that the new LTHW heating systems can be developed and extended to suit the long term needs of the Museum.

4.2.10 Heating Circuits

The heating circuit arrangements for the new systems are shown diagrammatically in Figure H4 and the principles are outlined below.

Primary Circuit

The new primary LTHW flow and return mains from each boiler house should be run to designated secondary pump chambers throughout the Museum to form complete primary circuits. The primary circuits should not serve any heat emitter directly.

All heat emitters should be served by pumped secondary LTHW circuits taken from the primary LTHW circuits via a heat exchanger.

Variable Temperature Circuits Serving Radiators, Natural Convectors and Pipe Coils

Radiators, natural convectors and pipe coils should be served by secondary LTHW variable temperature circuits so that the flow temperature of the water supplied to the heat emitters is reduced as the outside temperature increases.

The variable temperature controls for each circuit should comprise:-

- Three port modulating mixing valve
- Weather compensator utilising an outside temperature sensor, pipeline temperature sensor and control box
- Circulating pump.

Generally all radiators, convectors and pipe coils in a particular project should be served by separate variable temperature circuit. The external temperature sensor should be located on a north facing wall or in a shaded location where this is not practicable.

Zoning by orientation of the building facades should only be considered when the layout of the building lends itself to zoning.

Supplementary control valves should be considered to prevent overheating in areas which may be crowded on occasions.

Circuits Serving Embedded Underfloor Heating

Embedded underfloor heating systems should be served by secondary variable temperature circuits. Each circuit should be separately pumped and should not supply any other heat emitters.

Maximum water flow temperatures should be in the range of 45°C to 60°C, depending on the type and construction of the underfloor system installed.

The design should ensure that the floor temperatures do not create unacceptable levels of foot discomfort.

The temperature of the water supplied to the embedded floor heating systems should be reduced by a three-port modulating mixing valve working in conjunction with a fixed mixing connection.

Details of the controls to be installed should be submitted to the BMD P&PM for comments. Control systems should take into account the area to be served, its use and occupation.

Circuits Serving Heating Coils in Air Handling Units and Fan Coils Units

Air heating coils and fan coil units should be supplied via separately pumped secondary LTHW constant temperature circuits operating at 82°C flow and 71°C return under full load conditions.

The output of each air heating coil should be controlled by a three-port modulating diverter valve. The valves should work in conjunction with duct or room temperature sensors as required for the particular application.

The controls for anti-frost air heating coils should include provision to ensure that heating water at the correct temperature is flowing through the coil before air is allowed to pass through the coil.

Circuits Serving HWS Heaters

The Secondary LTHW circuits to HWS calorifiers/instantaneous heaters should be separately pumped to enable other secondary heating circuits to be shut down in the summer where appropriate without

affecting the HWS systems.

The temperature in each HWS calorifier/instantaneous heater should be controlled by a three-port diverting valve working in conjunction with an immersion thermostat. The control valve should incorporate a spring return device to close the valve should a high limit thermostat positioned at the top of the calorifier or in the HWS flow pipework sense that the temperature is above a pre-set level.

Circuits Serving Air Heating Coils Required for Summer Re-heat

Consideration should be given to providing separately pumped circuits to serve air heating coils which are required to operate during the summer to provide reheat for critical areas.

4.2.11 Thermostatic Radiator Valves

Radiators in offices and other non-public areas should be fitted with thermostatic radiator valves except where the number and location of staff make it preferable to prevent interference with the output of the radiators. Thermostatic radiator valves should not be used in public areas.

Only thermostatic radiator valves of good quality and having a proven record of use in both commercial and industrial situations should be considered. The make and type of thermostatic valve to be used should be agreed with the BMD P&PM, during the detail design stage of a project.

Care must be taken in the selection of thermostatic radiator valves to ensure that they are fully suitable and compatible with the variable temperature heating systems.

Where a high proportion of the radiators on a circuit are fitted with thermostatic radiator valves a pump head relief valve should be provided to cater for situations when a number of the thermostatic radiator valves are fully or nearly closed.

4.2.12 Zoning by Room Usage

Where the rooms in a project are likely to be occupied at significantly different times the heating system should be zoned to enable heating in unoccupied rooms to be shut off or reduced. Zoning maybe by separate circuits or by motorised zone isolating valves whichever is the most cost effective.

4.3 CHILLED WATER AND DX REFRIGERATION SYSTEMS

4.3.1 Basic Principles

Whenever possible comfort cooling and air conditioning plants should be served by chilled water or DX system.

Small to medium sized areas requiring comfort cooling and nominal fresh air ventilation may be provided with DX or DX- VRV system. Applied correctly, these systems are compact, energy efficient and offer flexibility for incremental development of space.

Air-cooled condensers should be used for all chilled water and direct expansion systems.

Cooling towers and evaporative condensers shall not be used.

Plants which are required to provide chilled water during the winter should be suitable for low ambient temperatures.

New equipment containing Refrigerants R11, R12 and R22 shall not be used.

Refrigerant R134a is the preferred choice but if suitable equipment is not available Refrigerant R407C may be considered.

4.3.2 Chilled Water Plants

The Museum is committed to use of Sustained Environment and Green Technologies where it is appropriate to do so. Alternative means such as Absorption Chilling, Absorption Chilling driven by CHP for generation of Chilled Water should be considered if the required cooling plant capacities are within the appropriate range for these alternatives. A full range of Options Analysis with life cycle costings should be carried out.

Where a new project requires cooling it should desirably be obtained from a location which can be developed progressively to serve future cooling requirements in the Sector in order to avoid a proliferation of scattered small plants. Distributed small plants are not completely ruled out as depending upon the size of the load they may provide the most cost effective solution and avoid excessive long runs of pipework to an otherwise central location. This aspect needs to be examined on project specific basis.

When it is agreed that a new chilled water/DX plant should be established, the Consultant should prepare recommendations on the location and development of the plant to meet initial and future loads. The recommendations should be submitted to the BMD P&PM for agreement.

The noise produced by chilled water and DX plants can be critical particularly if the plants are required to operate at night. For critical applications a noise level survey may be required. The need for a survey should be agreed with BMD P&PM.

Noise levels for the plant will need to be approved by the Local Authority. To comply with the Local Authority noise requirements, it may be necessary to employ the services of a noise specialist to define the specific requirements of any sound attenuation that may be required.

4.3.3 Chilled Water Circuits

Where the chilled water plant is required to serve a number of circuits with different temperature requirements, a primary circuit should be provided to circulate through the chilled water plants alone. All cooling coils, fan coil units, etc. should be served by pumped secondary circuits taken from the primary circuit. A buffer vessel shall be incorporated in the Primary Circuit.

The temperature of the primary chilled water supplied by the chilled water plants will be affected by the temperature and humidity requirements of the areas served. For comfort cooling systems and air conditioning applications, which fall within the comfort cooling range, the preferred primary chilled water temperatures are 6°C flow and 12°C return.

For temporary exhibition galleries, the lowest combination of temperature and humidity may require chilled water at a significantly lower temperature than that required for comfort cooling. It should be noted that loan conditions for temporary exhibitions may require robust air conditioning systems.

If glycol is required for low temperature chilled water plants, it should be of an environmentally acceptable type, non toxic and non corrosive.

Fan coil units should preferably be served by separately pumped secondary chilled water circuits fitted with mixing valves so that the temperature of the chilled water supplied to the fan coil units can be kept slightly above the chilled water supplied to the air handling units to reduce the possibility of condensation occurring on the fan coil units.

Chilled ceilings or chilled beams shall not be used without prior approval of the BMD P&PM section.

4.4 HOT AND COLD WATER SERVICES, FIRE SERVICES AND NATURAL GAS SERVICE

4.4 .1 Hot Water Service

The preferred options for supplying domestic hot water to new projects are:

- Isolated toilets, sinks and showers should be served by local electric heaters to avoid long runs of HWS circulating pipework

- Large kitchens should be supplied by direct gas fired water heaters or by storage calorifiers heated by LTHW. Two heaters or calorifiers should be provided each 50% of the total capacity required.

  For projects which are started before the heating systems are fully converted to LTHW it will be necessary to supply the calorifiers temporarily with MTHW, although the heating coils should be sized for LTHW

- Major toilet facilities located close to calorifier rooms or pump chambers should be served by storage calorifiers heated by primary at LTHW(82°C/71°C) or temporarily by MTHW as appropriate

- Major toilet facilities which are remote from pump chambers or calorifier rooms should be served by local electric heaters or a storage calorifier whichever is the most cost effective.

The boiler plants may not have sufficient capacity to supply large instantaneous water heaters and this type of heater should only be considered for small capacity applications where the preferred options are impracticable.

Storage calorifiers should be fitted with electric immersion heaters for use when a major shutdown of the heating systems is necessary.

In general, storage calorifiers should be of the vented type and served by a cold water tank. Unvented HWS systems connected direct to the cold water main may be considered in situations where a vented system would be difficult to accommodate. The BMD P&PM agreement should be obtained to the use of unvented systems. Storage calorifiers should be fitted with anti stratification pump and the system designed to raise the contents to 70°C for a short time for pasteurisation.

4.4.2 Cold Water Services

Cold Water Main

The Museum has a long term plan to provide a new CWM ring main generally under the inner road. Design Teams involved with new projects which have a requirement for cold water should make themselves familiar with the latest position on the design and installation of the new ring main and take this into account when designing the cold water services for a particular project. Where appropriate new cold water main pipework should be suitably valved so that it can be connected to the new ring main with minimum of disruption to the service. Valves should be located outside galleries and public areas.
The need for drinking water supplies should be considered for projects involving new or refurbished toilet facilities or kitchen facilities. The requirements should be shown on the Room

Data Sheets.

Cold Water Down Services

WC and urinal cisterns should generally be served by CWDS from a storage tank to ensure that the cisterns can continue to operate normally for a reasonable period (say 3 to 4 hours) if the CWM fails. WC and urinals may be served direct from the mains where permitted by the bylaws and using appropriate devices to prevent cross contamination.

Until the new CWM ring main is installed it will generally be necessary to serve wash basins by CWDS to avoid overloading the existing CWM system. When the new CWM ring main is in operation it should be possible to connect wash basins direct to the CWM where this is desirable and cost effective.

Small isolated toilet facilities may be connected to the CWM when it is difficult or expensive to provide CWDS.

All new cold water storage tanks should conform to BS 4213 and the Water Regulations.

4.4.3 Fire Services

Fire Hydrants

A new fire hydrant ring main will be installed generally under the inner road to serve fire hydrants throughout the site. Design Teams involved with new projects should make themselves familiar

with the latest position on the design of the ring main.

The schematic layout of the hydrant ring main is shown on Drawing M000003.

Hosereels

A new pumped hosereel ring main will be installed generally along the same route as the fire hydrant ring main.

Final Sketch Designs are being prepared for upgrading the fire hosereels throughout the Museum. Design Teams should take into account the FSD proposals when they become available and should incorporate the requirements into specific projects as appropriate.

Designers of projects which proceed before the hosereel FSD' s are complete should liaise with the Designers preparing the FSD' s and should make an appropriate allowance in the project design to avoid the need to re-visit sensitive areas in order to add hosereel pipework at a later date.

The schematic layout of the hosereel ring main is shown on Drawing M00003.

Sprinklers

A sprinkler system for the site is at present under development. Existing underground water storage tanks at the northern end of the site has been refurbished and sprinkler pumps installed to supply the Great Court system. In future, new Sprinkler main, Hydrant main and Hose Reel main

will progressively be installed around the site.

The Museum' s Fire Safety Advisor should be consulted on the need for sprinklers on specific projects and the Room Data Sheets should state which areas require sprinklers.

Dry Risers

The Museum' s Fire Safety Advisor should be consulted on the need for dry risers for specific projects and the Room Data Sheets should state which areas require dry risers.

Gaseous Fire Extinguishing Systems

The Museum does not have an overall policy for the use of gaseous fire extinguishing systems in specific areas.

If gaseous fire extinguishing systems are considered necessary for particular areas the requirements should be reviewed by the Fire Safety Advisor and agreed by the BMD P&PM.

4.4.4 Natural Gas

A boosted gas supply was installed in 1997 to serve the boiler house at Substation D and the existing boiler house in Sector F. The boosted main also has provision to serve the Great Court Kitchen and can if required, be extended to connect up existing non-boasted gas supplies which serve discrete areas of the Museum.

The design outlet pressure for the gas boosters is 20 in.wg.

New projects which require a significant gas supply should, wherever possible, be connected to the boosted gas supply. Gas regulators should be installed to reduce the boosted gas pressure to the pressure required for the particular project.

Before a significant new user is connected to the boosted gas main the capacity of the main and the boosters should be checked to confirm that they are adequate to serve the new total load for the site.

APPENDIX A

HEALTH & SAFETY FILE/OPERATING AND MAINTENANCE MANUALS

APPENDIX A Operating and Maintenance Manuals

This file shall be compiled as required in CDM Regulations Harmonisation Document

APPENDIX B

VALVE NUMBERING PROCEDURE

APPENDIX B

VALVE NUMBERING PROCEDURE

1. Basic Requirements

$ Each valve to have a unique number

$ Valve labels to contain minimum information necessary to enable the valve to be identified from a valve schedule.

$ Valve Schedules to give comprehensive information on each valve

$ Numbering system to be capable of development to serve future projects

$ Valve labels to be readable in cramped/dirty locations

$ Valve label to be coloured to easily distinguish service

2.0 PIPEWORK SERVICES

The following pipework services shall be covered by the valve numbering system

Full Name of Service	**Abbreviation to be used in drawings**	**Abbreviations to be used on Valve Label**
Medium temperature hot water heating	MTHW	MT
Low temperature hot water heating	LTHW	LT
Hot water service	HWS	HWS
Chilled water	CHW	CHW
Low temperature chilled water	LTCHW	CHW(LT)
Cold water main	CWM	CWM
Cold water down service	CWDS	CWDS
Boosted cold water service	BCWS	BCWS
Drinking water service	DWS	DWS
Cold feed	CF (Service Abbrev)	CF (Service Abbrev)
Open vent	OV (Service Abbrev)	OV (Service Abbrev)
Treated water	TW	TW
Gas	GH	G
Sprinklers	S	S
Hosereels	HR	HR

3.0 VALVE LABELS

Valve labels should give the following information:-

Service
Location of valve
Valve number

The service should be identified by the abbreviation given in the schedule.

The location valve should preferably be given by the number of the room in which the valve is fitted.

Valves which are not fitted in numbered room should generally be identified by DIS/Level (DIS is the abbreviation for Distribution).

Valves in each room should be numbered sequentially starting at 1. The valve numbering should not be differentiate between manual and motorised valves.

Distribution valves on each level should be numbered sequentially started at 101. Number 1 to 100 are reserved for existing distribution valves if required.

Drain valves and check valves/non-return valves should not normally be numbered.

Examples of valve label information are given at the end of Appendix D.

Calve labels numbered and letters should be as large as possible and not less than 10 m high.

Valve labels shall be circular (50 mm diameter) and should be attached to the valve by a brass key ring or chain.

Samples of valve labels should be submitted to the BMD P&PM for approval.

4.0 VALVE SCHEDULE

A valve schedule should be produced for each project. The information given on the valve schedule should be generally as shown on the Example Schedule given at the end of Appendix D.

5.0 INFORMATION TO BE SHOWN ON DRAWINGS AND FLOW DIAGRAMS

The information on the valve labels shall be shown on record drawings and flow diagrams and on framed copies of flow diagrams mounted in plant rooms.

6.0 ALLOCATION OF VALVE NUMBERS

These use of room numbers as part of the valve identification procedure should make it unnecessary for the Museum to allocate numbers to valves fitted in specific rooms. Where a room contains existing numbered valves, the Designer of new project should refer to the existing valve schedules for the room before numbering valves.

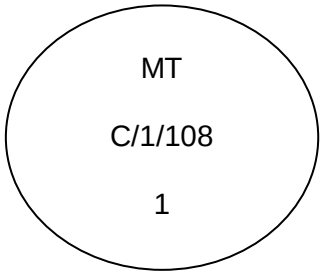
The pipework distribution systems will need to be extended and modified throughout their lives to cater for new projects. To avoid valve numbering errors the BMD P&PM will allocate valve numbers for all distribution systems, based on information provided by the project designers.

7.0 COLOURING OF VALVE LABELS

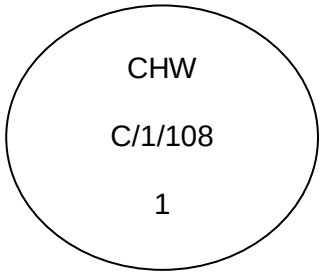
The colours of the valve labels should be as follows:-

Service	**Label (Colour Reference B.S4800)**	**Lettering**
Mains water	Dark blue (18E 53)	White
Cold water service	Light blue (18E 51)	White
Heating water	Crimson (04D 4)	White
Fire service	Red (04E 53)	White
Natural gas	Yellow (10E 53)	Black
Chilled water	Emerald green (14E 53)	White
Domestic hot water	Green (12D 45)	White

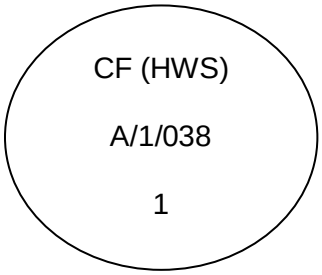
8. Valve Label Examples



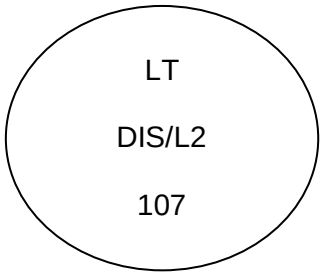
MTHW Valve 1 fitted in Room C/1/08



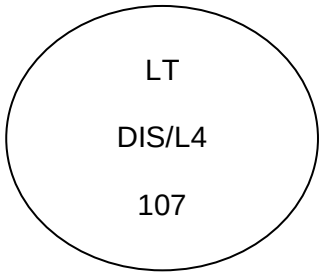
CHW Valve 1 fitted in Room C/1/08



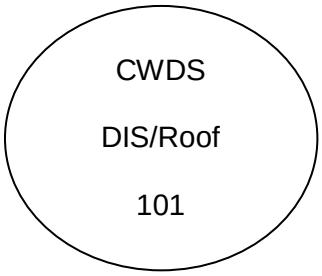
Cold Feed Valve 1 on HWS in Room A/1/038



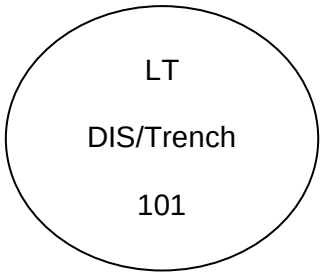
Valve 107 on LTHW Distribution at Level 2



Valve 107 on LTHW Distribution at Level 4



Valve 101 on CWDS Distribution on the Roof



Valve 101 on LTHW Distribution in Trench

VALVE SCHEDULE EXAMPLE
PROJECT .....

Information on Valve Label						**Reference**	**Size**		**Model**	
Service	**Location**	**No.**	**Purpose**	**Type**	**Location**	**Drawing**	**mm**	**Manufacturer**	**No.**	**Comment**
MT	C/1/108	1	Isolation of flow to Htg Cal.1	Manual parallel slide	Room 1/W/9 (New Win Plant Room) Flow to Htg Cal. 1	M 100010 M 100011	50	Hopkinson	M219016	
CHW	C/1/108	1	Control of CHW to cooling coil	Motorised three port control valve	Room 1/W/9 (new wing plant room) Flow to coil	M 10010 M 100011	80	Honeywell		
CF(HWS)	A/1/038	1	Isolation of cold feed to HWS Cal 1	Manual gate	Room 1/E/24 (Calorifier Room 5 inlet to HWS Cal 1	M 100020 M 100021	80	Hattersley	33X	
LT	DIS/L4	107	Regulation of return from Galleries X, Y, Z	Y pattern commissioning set	Level 4 Grid Ref G8 high level	M 100040	50	Hattersley	CV 2432	
LT	DIS/L4	107	Regulation of return from Galleries X, Y, Z	Y pattern commissioning set	Level 4 Grid Ref G8 high level	M 100040	50	Hattersley	CV2432	
CWDS	DIS/Roof	101	Isolation of Storage Tank 1	Manual gate	Roof Grid Ref G8 Outlet from Tank 1	M 100050 M 100051	100	Hattersley	M511PN10	
LT	DIS/Trench	101	Isolation of flow to AHUs A, B, C	Manual gate	Trench Grid Ref G8	M 100060 M 100061	50	Hattersley	33X	

APPENDIX C

PREFERRED SUPPLIERS

APPENDIX C

MECHANICAL SERVICES - PREFERRED SUPPLIERS

Equipment	Preferred Suppliers				
AIR HANDLING EQUIPMENT					
Air Handling Units	ABB	Holland Heating	Senior Moducel	VES Andover	
Fans					
Centrifugal fans					
Axial flow fans	Woods				
Twin fan units	Kiloheat				
In-line centrifugal fans	Roof Units				
Roof extract fan units	Roof Units	Woods	Powermatic Ltd		
Humidifiers					
Steam generator type with electric resistance elements	J &S Humidification	Vapac			
Steam generator type with electrodes	J &S Humidification	Vapac			
Ultra Sonic	J &S Humidification				
Activated carbon and adsorption filters	Emcel Filters	AAF	Camfil	Farr Europe	

Equipment	Preferred Suppliers				
Acoustic Treatment					
Attenuators	Sound Attenuation Ltd				
Acoustic louvers					
Vibration Isolation	Sound Attenuation Ltd				
Grilles and Diffusers	Senior Coleman	Krantz	Halton		
Fire & Smoke Dampers	Actionair				

Equipment	Preferred Suppliers				
HEATING EQUIPMENT **Boilers, Chimneys and Flue Gas Ductwork**					
Large packaged LTHW boilers	Ygnis				
Burners for large boilers	Nuway				
Metal chimneys					
Pressurisation Units	Pressurisation Ltd	Pillinger	Armstrong		

Equipment	Preferred Suppliers				
Water Treatment					
Water treatment plant	Permutit				
Corrosion inhibitors	Fernox				
Specialist water treatment contractors	Fernox				
Pumps					
Horizontal direct driven pumps	Pullen	Holden & Brook			
Vertical pumps	Grundfurs				
Belt driven pumps	Pullen	Holden & Brook			
Canned rotor pumps	Crane				
Sump pumps	Crane				

Equipment	Preferred Suppliers				
Calorifiers, Plate Heat Exchangers					
Non-storage calorifiers	HRS				
Plate heat exchangers	HRS	Sandex	Stokvis		
Space Heating Equipment					
Radiators	Hudaved	Stelrad			
Natural convectors	Dunham Bush				
Fan convectors	Dunham Bush				
Unit heaters	Hovel				
Radiant panels					
Embedded floor heating					

Equipment	Preferred Suppliers				
Valves, Commissioning Sets, Drain Cocks and Air Vents					
MTHW isolating valves	Hattersley 940/950	Crane			
MTHW regulating valves	Hattersley	Crane			
MTHW commissioning sets	Hattersley AMetrex@	Crane			
MTHW drain cocks	Hattersley Fig.33	Crane			
LTHW isolating valves	Hattersley	Crane			
LTHW regulating valves	Hattersley	Crane			
LTHW commissioning sets	Hattersley	Crane			
LTHW drain cocks	Hattersley	Crane			
LTHW manual radiator valves	Pegler	Crane			
LTHW Thermostatic Radiator Valves	Danfoss	Honeywell			
LTHW automatic air vents	BSS				

Equipment	Preferred Suppliers				
Miscellaneous Equipment					
Thermometers					
Pressure gauges					
Strainers					
CHILLED WATER AND DX REFRIGERATION EQUIPMENT					
Packaged air-cooled chilled water plants	Carrier	Dakin	York		
Remote condenser water coolers	Carrier	Dunham Bush	York		

Equipment	Preferred Suppliers				
Chilled Water and Space Cooling Equipment					
Fan coil units	Diffusion	Dakin	IIMI		
Chilled Water Valves, Commissioning Sets, Drain Cocks and Air Vents					
Isolating valves	Hattersley	Crane			
Regulating valves	Hattersley	Crane			
Commissioning sets	Hattersley	Crane			
Drain cocks	Hattersley	Crane			
Automatic air vents	BSS				
Packaged Direct Expansion Air Conditioning Systems	Carrier	Dakin	IMI		

Equipment	Preferred Suppliers				
HOT AND COLD WATER SERVICES					
Water Heaters and Calorifiers					
Gas-fired water heaters	Andrew	Potterton			
Electric water heaters	Sadia	Heatrae			
Plate Heat Exchangers	Stokvis	HRS	APV		
Storage calorifiers					
Booster sets	Pillinger	Pullen			
Cold Water Storage Tanks					
Plastic storage tanks					
Steel storage tanks					
Potable water tanks					

Equipment	Preferred Suppliers				
Regulating valves	Hattersley	Crane			
Commission sets	Hattersley	Crane			
Drain cocks	Hattersley	Crane			
Stopcocks	Yorkshire				
Bib taps	Yorkshire				
Float valves/ballcocks					
Miscellaneous Equipment					
Shower valves and associated equipment	Aqualisa				
Shower pumps	Aqualisa				

Equipment	Preferred Suppliers				
FIRE SERVICES					
Sprinklers					
Complete sprinkler installations above ,50 000	Angus Fire Armour	Bush Engineering	Crown House Engineering	Hayden Young	Matthew Hall
Complete sprinker installations below ,50 000	Angus Fire Armour		Crown House Engineering	Haden Young Fire Engineering	Matthew Hall
Sprinkler valve sets	Angus Fire Armour				
Sprinkler heads	Angus Fire Armour	Reliable Sprinkler Co	Lansdale - Viking		
Gas Suppresion Systems	Ginge-Kerr	Hygood	Sure Fire Systems		

Equipment	Preferred Suppliers				
Hosereels and Fire Extinguishers					
Hosereels	Chubb Multi-way type				
Manual fire extinguishers	Chubb				
Gaseous extinguisher systems	Chubb				
Foam extinguisher systems	Chubb				
Dry powder extinguisher systems	Chubb				
Valves and Hydrants					
Isolating valves					
External hydrants					
Landing valves					
Dry riser valves					
Foam inlet valves					

Equipment	Preferred Suppliers				
NATURAL GAS SERVICE					
Meters, Valves, Regulators, etc					
Meters					
Main isolating valves					
Gas cocks					
Manual emergency isolation valves					
Automatic shut-off valves					
AUTOMATIC CONTROLS					
Controls, BMS system and interface equipment	Trend				
Testing & Commissioning	Commtech Ltd	Dome Documentation Ltd			
ELECTRICAL EQUIPMENT					
Refer to Electrical Harmonisation Document					

APPENDIX D

ROOM DATA SHEETS

APPENDIX D

ROOM DATA SHEETS FOR MECHANICAL SERVICES

GUIDANCE NOTES

1. Introduction

These Guidance Notes should be read in conjunction with the Mechanical Services Harmonisation Document.

A Room Data Sheet should be prepared for each room in the Project to define the design criteria.

The headings in the Guidance Notes relate to the headings on the Room Data Sheets.

2. General Information

$ The room dimensions, area and volume are intended to assist the early basic planning stages of the project. A high level of accuracy will generally not be required.

An average room height will generally be adequate

$ The daily occupied hours should be standard working hours unless a significant number of people work outside these hours.

$ If there is a significant difference between the average and peak number of occupants the approximate duration of the peak should be stated.

3. Environmental Information

3.1 General Policy

$ Wherever possible rooms should be served by simple heating and natural ventilation to minimise capital and running costs.

$ Where natural ventilation is not possible mechanical ventilation is the preferred option

$ Comfort cooling and air-conditioning should only be considered when natural or mechanical ventilation will not provide tolerable conditions.

$ Air-conditioning should only be provided where full control of environmental conditions is essential to safeguard artefacts or to ensure the satisfactory operation of sensitive equipment

3.2 Heating and Natural Ventilation

$ A minimum temperature during unoccupied hours should only be given when the room contains items which will suffer if the temperature falls too low

$ The external design temperature for rooms which require the full temperature to be maintained during the night should be -4.5°C

$ For rooms where heating is only required during the day the external design temperature can be -3°C

$ It is not envisaged that close temperature control limits will be required in rooms with simple heating, but for critical rooms the control limits should be stated.

3.3 Mechanical Ventilation

$ The amount by which the summer design temperature can exceed the ambient temperature should be kept as large as possible to avoid the need for excessive ventilation

$ The air change rate should be given only when this is the design criteria (eg toilet ventilation)

$ Activated carbon filters to remove pollutants are expensive and should only be specified when they are essential to safeguard the artefacts. Where activated carbon filters are required the pollutant limits should be stated. This guidance note also applies when activated carbon filters are required for comfort cooling and air conditioning applications

$ Wherever possible the type of system should be stated, (eg extract only, supply and extract, displacement ventilation, etc). This guidance note also applies to comfort cooling and air-conditioning applications.

3.4 Comfort Cooling

$ Comfort cooling systems should not include humidifiers

$ An upper relative humidity limit may be specified when this can be simply achieved by the comfort cooling system at minimal cost.

3.5 Air-Conditioning

$ This section of the Room Data Sheet is intended for those rooms where full control of environmental conditions is essential to safeguard the condition of the artefacts. There may also be isolated instances where rooms contain sensitive electronic equipment which require full control of environmental conditions

$ The Room Data Sheet allows for a wide range of requirements to be specified but over specification should be avoided as it will almost certainly increase costs

$ The lowest and highest combinations of temperature and humidity should only be specified when the room will need to be maintained at different conditions to suit the artefacts. It is envisaged that this requirement will mainly apply to temporary exhibition rooms where the type of artefact will change

$ Maximum permissible rates of temperature or humidity change should only be specified where a rapid short term change of conditions would damage the artefacts or cause electronic equipment to malfunction

$ If a minimum RH level is specified the air conditioning designer will invariably include a humidifier in the system in order to guarantee that the RH does not fall below the specified level. It is possible, however, that the natural RH level of an area may be above the lowest permissible RH level even in cold weather and consequently humidification may not be required.

If experience or RH measurements taken during the winter show that the natural RH is very unlikely to fall below 30%, consideration should be given to omitting humidification except for rooms which require a minimum RH of 40% and above.

If humidification can be omitted, this should be stated on the Room Data Sheets.

$ Alarm conditions should be set as wide as possible.

3.7 Other Environmental Information

$ The section should be used to provide information which is not covered by other sections of the Room Data Sheets (eg, the use of environmentally controlled display cases, dust or fume extract requirements for workshops, the need for standby equipment etc)

$ It may also be helpful to include brief statements which assist the designers to gain a comprehensive understanding of the project (eg the reasoning which lead to any abnormal requirements).

4. Pipework Services

$ Where possible the number and type of CWM, CWDS and HWS outlets should be given (ie 3 sinks, 2 basins etc)

$ Other pipework information should include statements on the provision of future or increased sized services to serve adjacent areas.

5. Approval of Room Data Sheets

The Room Data Sheets are the basis of the mechanical services design and the sheets should be approved an signed off by all interested parties.

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ROOM DATA SHEET FOR MECHANICAL SERVICES

PROJECT.....

Room	Room Data Sheet
Name Number of Reference Sector Level	RDS Ref Issue Date Revision

General Information

Length m	Width m	Height m	Area m5	Volume m;

Daily Occupied Times			Occupancy	Number of Occupants	
Start	Finish	Hours/Day	Days/Week	Average	Peak

Other General Information:

Environmental Information

Heating and Natural Ventilation

Winter Design Temperature During Occupied Hours °C	Minimum Temperature During Unoccupied Hours °C	External Design Temperature °C Dry Bulb

Mechanical Ventilation

Winter Design Temp During Occupied Hrs °C	Minimum Temp During Unoccupied Hours °C		External Design Temp °C Dry Bulb			
			Heat Losses		Anti-Frost	
Summer Design Temp °C Above Ambient Temp	Minimum Fresh Air litres/sec per Person		Air Change Rate			
Winter Temperature Control Limits	Dust Filtration Standard		Filtration of Gaseous Pollutants			
	Primary	Secondary	SO_2	NO_2	O_3	Others
Sound Level NR	Type of System:					

Comfort Cooling

Winter Design Temp During Occupied Hrs °C		Min Temperature During Unoccupied Hours °C				Winter External Temp °C Dry Bulb	
						Heat Losses	Anti-Frost
Summer Design Temp °C		Upper RH Limit %				Summer External Design Conditions	
						°C Dry Bulb	°C Wet Bulb
Temperature Control Limits		Minimum Fresh Air litres/sec per Person				Heat Gains from Equipment Watts	
Dust Filtration Std		Filtration of Gaseous Pollutants				Sound Level NR	
Primary	Secondary	SO_2	NO_2	O_3	Others		
Type of System:							

Air Conditioning

Min Temp °C		Max Temp °C		Minimum RH %	
Occupied Hours	Unoccupied Hours	Occupied Hours	Unoccupied Hours	Occupied Hours	Unoccupied Hours

Maximum RH %		Lowest Combination of Temperature & Humidity		Highest Combination of Temperature and Humidity	
Occupied Hours	Unoccupied Hours	Dry Bulb °C	RH %	Dry Bulb Temperature °C	RH %

Control Set Points		Control Limits		Maximum Permissible Rate of Change	
Temp °C	RH %	Temp °C ±	RH % ±	Temperature °C/h	RH %/h

Temp Alarm Limits				RH Alarm Limits				Winter External Design Conditions		
First Stage		Second Stage		First Stage		Second Stage		Low °C Dry Bulb	°C Wet Bulb	Anti-Frost °C
High °C	Low °C	High °C	Low °C	High °C	Low °C	High °C	Low °C			

Summer External Design Conditions		Design Air Inlet Temp to Air Cooled Condensers		Minimum Fresh Air litres/sec per Person
°C Dry Bulb	°C Wet Bulb	Max °C	Min °C	

Heat Gain from	Dust Filtration Std					Filtration of Gaseous Pollutants
Equipment Watts	Primary	Secondary	SO_2	NO_2	O_3	Others
Sound Level NR						
	Type of System					

Other Environmental Information

Pipework Services

Cold Main	CWDS	HWS	Hosereels	Sprinklers	Others
Other Pipework Information:					

Signed..... BM Conservation Date.....

Signed..... BM Design Office Date.....

Signed..... Project Leader Date.....

Signed..... System Coordinator Date.....

Signed..... Others (specify) Date.....

APPENDIX E

Pipework and Insulation Data Sheets

E.1 PIPEWORK MATERIALS DATA SHEET

Services	Range	Tube	Fittings
L.P.H.W	Up to 40 mm	Black Mild Steel Heavy Weight	Screwed fittings
	Above 40 mm and up to 125 mm	Black Mild Steel Heavy Weight	Butt Welding fittings with flanges
Compressed Air	Up to 50 mm	Galvanised Steel Heavy Weight	Screwed Fittings
	Above 50 mm	Galvanised Steel Heavy Weight	Flanged Fittings
M.T.H.W	All sizes	Carbon Steel Seamless, Heavy	Carbon Steel welded throughout
Mains Water Cold Water Hot Water	Up to 150 mm	Copper	›Yorkshire potable‹, Soldered/brazed throughout.
Chilled Water	Up to 50 mm Above 50 mm	Black Mild Steel Medium Heavy weight	Screwed fittings Butt welding fittings
Hose Reels	Up to 50 mm Above 50 mm	Galvanised steel Heavy Weight	Screwed fittings Flanged
Sprinklers	Up to 50mm Above 50 mm	Black Mild Steel, Heavy	Screwd Fittings Flanged

E.2 INSULATION FINISHES DATA SHEET

ITEM	SERVICE TEMPERATURE °C	LOCATION	FINISH
Pipework	Above 20°C	Plant Rooms	Hammerclad Aluminium
		Service Ducts False Ceilings Voids	Canvas Cotton
		Floor Ducts and Exposed to outside	Canvas, covered with 0.8 mm plolyisobutylene sheet, solvent welded*
		Exposed to view	Hammerclad Aluminium
Pipework	Below 20°C	Plant Rooms	Hammerclad Aluminium
		Service Ducts False Ceilings Voids	Aluminium Foil
		Floor Ducts	Aluminium Foil, covered with 0.8mm
		Exposed to view	Hammerclad Aluminium
Ductwork	Above 18°C	Plant Rooms	PVC or GRP sheet
		Service Ducts False Ceilings Voids	Aluminium Foil
		Exposed to view	PVC or GRP Sheet
		Exposed to outside	0.8 mm polyisobutylene sheet solvent welded*
Ductwork	Below 18°C	Plant Rooms	PVC or GRP Sheet
		Service Ducts False Ceilings Voids	Aluminium Foil
		Exposed to view	PVC or GRP sheet
		Exposed to outside	0.8 mm polyisobutylene sheet Solvent welded*

* Were exposed to outside, the whole of the insulation to be then covered with galvanised wire mesh.

E.3 SCHEDULE OF ITEMS TO BE INSULATED

- Heating pipework including valves and fittings
- Chilled Water pipework including valves, pumps and fittings
- Supply and extract air ductwork exposed to outside
- Supply air ductwork carrying chilled air
- Supply air ductwork associated with Warm Air Heating System
- Hot Water Pipework
- Hot Water Calorifier
- Refrigerant Pipework associated with DX Split Systems
- Boiler Flues
- Coldwater Tank
- Cold Water Pipework
- MTHW Pumps

S Plate Heat Exchangers

S Heating Calorifiers

APPENDIX F

TESTING AND COMMISSIONING

TESTING AND COMMISSIONING

Pre- commissioning flushing and cleaning shall be carried out strictly in accordance with BSRIA and CIBSE recommendations.

Prior to initial system filling and flushing, items of equipment, such as heater batteries, cooling coils, chilled ceilings/beams, control valves, commissioning Sets etc. shall be provided with bypass loops or stool pieces as appropriate. Large dia. flushing valves shall be provided at the lowest parts of the system.

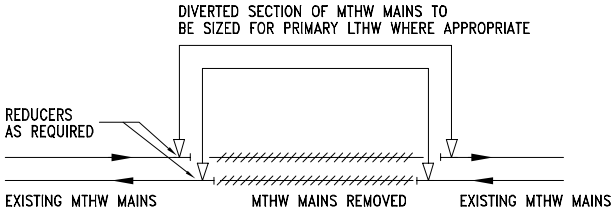
Hot and cold water services shall be flushed and disinfected in accordance with Water Bylaws.

Prior to start-up, ventilation/air conditioning duct work and air handling units shall be thoroughly cleaned internally and all dust and debris removed. After the fans have been run and system balanced and commissioned, a clean set of filters shall be installed in all air handling units prior to handover.

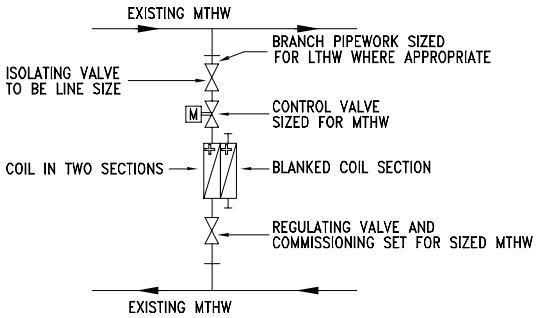
All pre-commissioning cleaning shall be witnessed by BMD P&PM representative.

APPENDIX G

DRAWINGS/SKETCHES

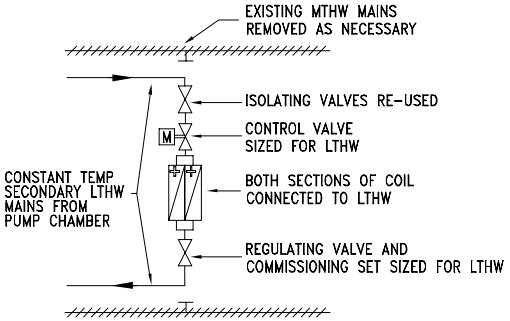


TYPICAL DIVERSION OF MTHW MAINS



INITIAL ARRANGEMENT

COIL CONNECTED TO MTHW



FINAL ARRANGEMENT

COIL CONNECTED TO SECONDARY LTHW

NEW AIR HEATING COIL CONNECTED INITIALLY TO MTHW

Figure H1

151950/M305

Rev	Date	Modification	Alt	DO Chk	Orig Chk	App
A	06 07 98	MINOR AMENDMENTS	PJB			RWB
B	12 11 99	MINOR AMENDMENTS	DRW			

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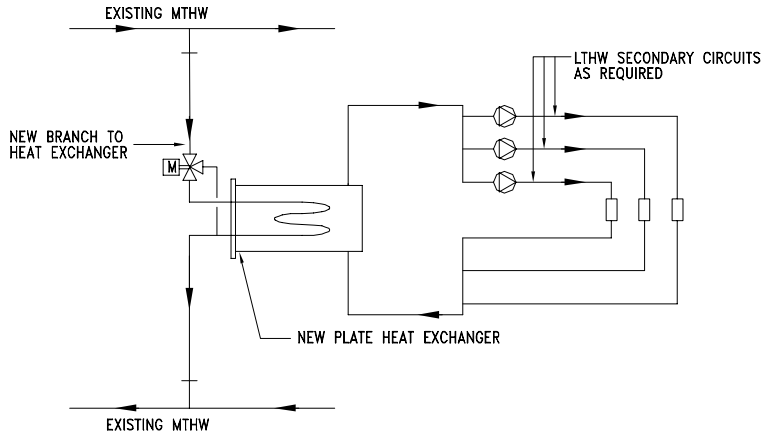
Key:

Contractor:			Scale: NTS
Drawn PJB	DO Chk SPB	Orig Chk	Approved RWB
Date 13.12.97	Date 15.12.97	Date	Date 15.12.97

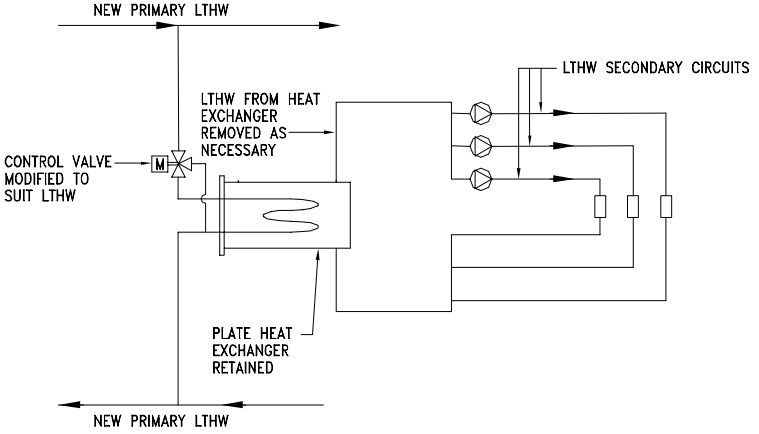
Title: MECHANICAL HARMONISATION C/O PRINCIPLES MTHW TO LTHW DIVERSION OF MTHW MAINS AND AIR HEATING COIL CONNECTIONS

Drawing No. M000020 Rev. B



INITIAL ARRANGEMENT

PROJECT CONNECTED TO MTHW



FINAL ARRANGEMENT

PROJECT CONNECTED TO PRIMARY LTHW

Figure H2

151950/M306

Rev	Date	Modification	Alt	DO Chk	Orig Chk	App
A	06 07 98	MINOR AMENDMENTS	PJB	SPB		RGC
B	12 11 99	MINOR AMENDMENTS AND FINAL ARRANGEMENT ADDED	DRW	SPB	ART	RGC
C	03 12 99	MINOR AMENDMENTS	BE			

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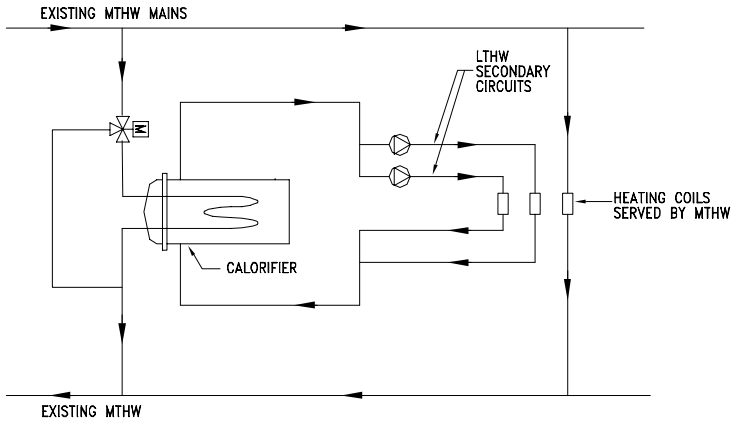
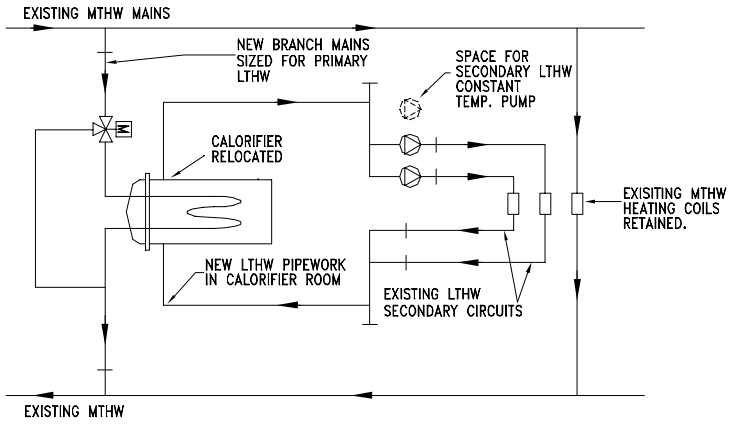
Key:

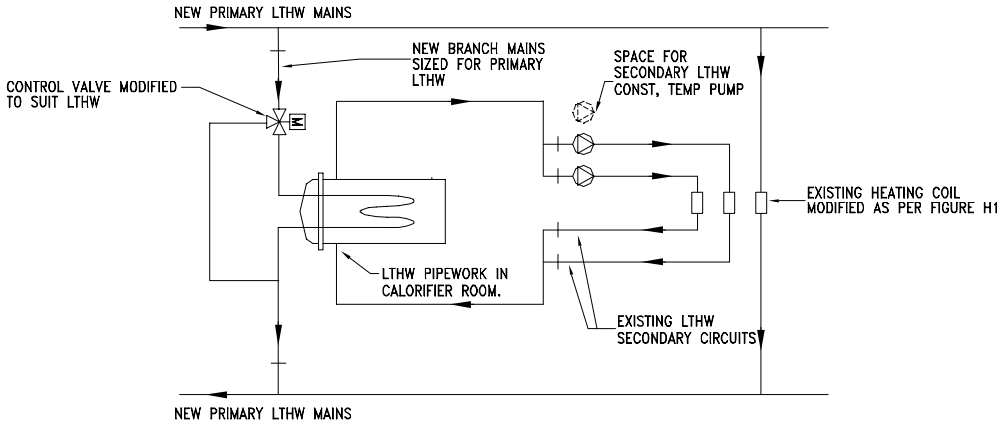
Contractor:			Scale:	Title:
			NTS	MECHANICAL HARMONISATION C/O PRINCIPLE MTHW TO LTHW NEW PROJECT CONNECTED INITIALLY TO MTHW SYSTEM
Drawn PJB	DO Chk SPB	Orig Chk	Approved RWB	Drawing No. M000021
Date 13.12.97	Date 15.12.97	Date	Date 15.12.97	Rev. C



TYPICAL EXISTING ARRANGEMENT



TYPICAL RELOCATION OF CALORIFIER ROOM



FINAL ARRANGEMENT ALL CIRCUITS SERVED BY LTHW

Figure H3

151950/M307

Rev	Date	Modification	Alt	DO Chk	Orig Chk	App
A	06 07 98	MINOR AMENDMENTS	PJB			
B	19 11 99	MINOR AMENDMENTS AND FINAL ARRANGEMENTS ADDED	DRW	SPB	ART	RGC
C	03 12 99	MINOR AMENDMENTS	BE			

THE BRITISH MUSEUM

Key:

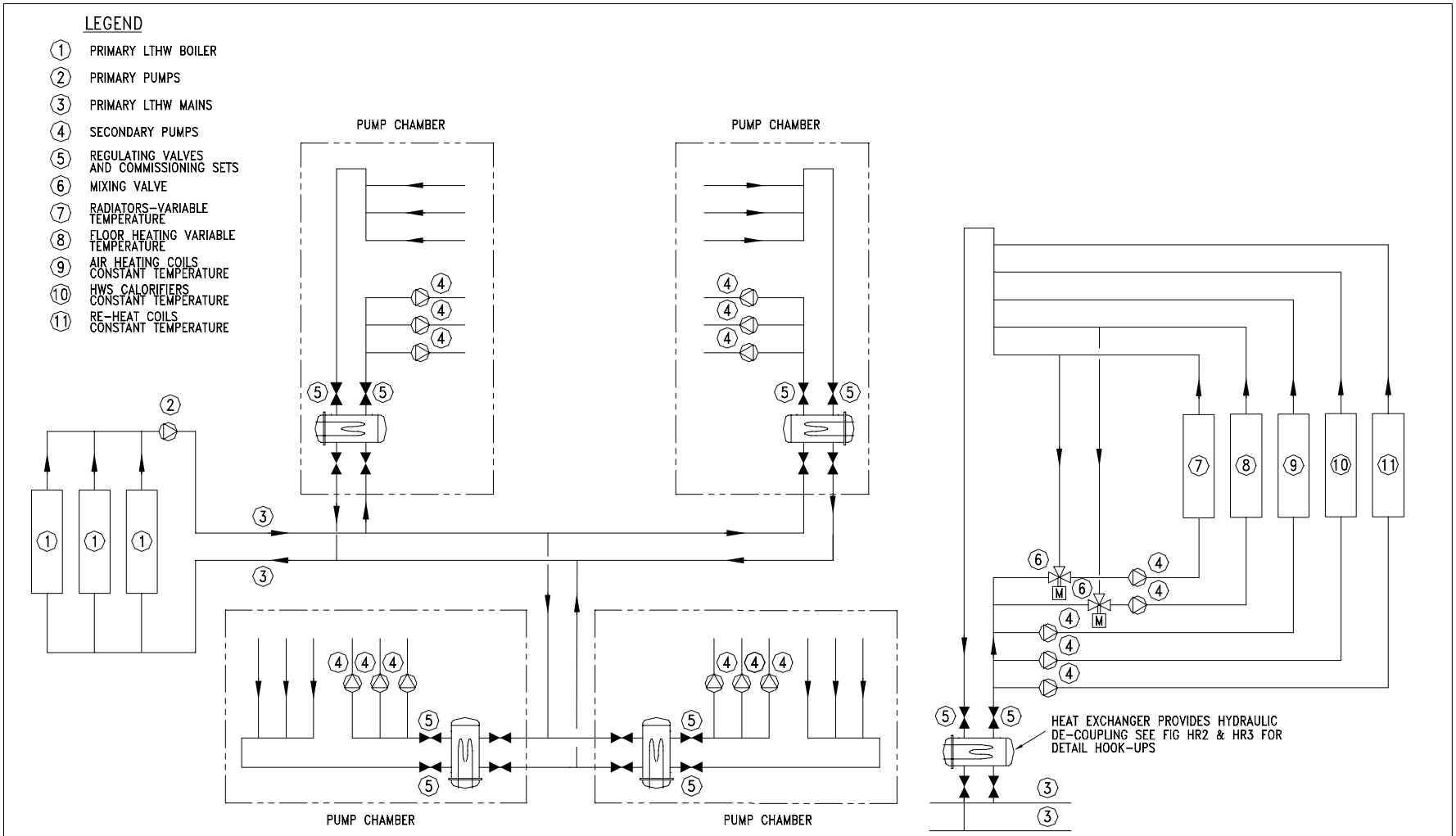
Contractor:

Scale: NTS

Drawn	DO Chk	Orig Chk	Approved
PJB	SPB		RWB
Date 13.12.97	Date 15.12.97	Date	Date 15.12.97

Title: MECHANICAL HARMONISATION C/O PRINCIPLES MTHW TO LTHW RELOCATION OF EXISTING CALORIFIER ROOMS

Drawing No. M000022 Rev. C



NOTIONAL DIAGRAM OF LTHW DISTRIBUTION SYSTEM

TYPICAL LTHW PUMP CHAMBER DIAGRAM

Figure H4

151950/M308

Rev	Date	Modification	Alt	DO Chk	Orig Chk	App
A	19 11 99	MINOR AMENDMENTS	DRW	DKG	ART	ART
B	22 02 00	4 x HEAT EXCHANGERS ADDED	BE	SPB	ART	ART
C	11 05 00	TITLE MODIFIED	BE			

THE BRITISH MUSEUM

Key:

Contractor:

Scale: NTS

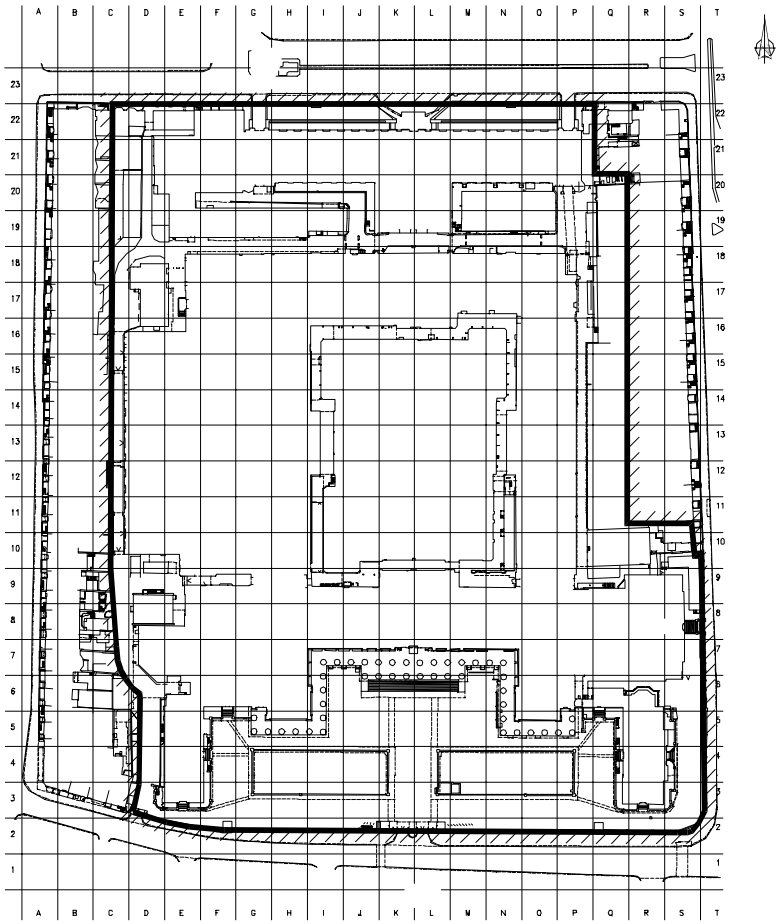
Drawn PJB | DO Chk | Orig Chk | Approved RDB

Date 13.12.97 | Date | Date | Date 13:12:97

Title: MECHANICAL HARMONISATION NEW LTHW HEATING SYSTEM NOTIONAL DIAGRAMS OF DISTRIBUTION MAINS AND PUMP CHAMBERS

Drawing No. M000023 Rev. C

DORF: 2038



10 0 10 20 30 40 50 60 70 80 90 100 metres

SCALE – 1 : 750

Rev	Date	Modification	All	RG	Chk	App

THE BRITISH MUSEUM

Key:

Contractor:
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Consulting Engineers
Shoot House East Byfleet
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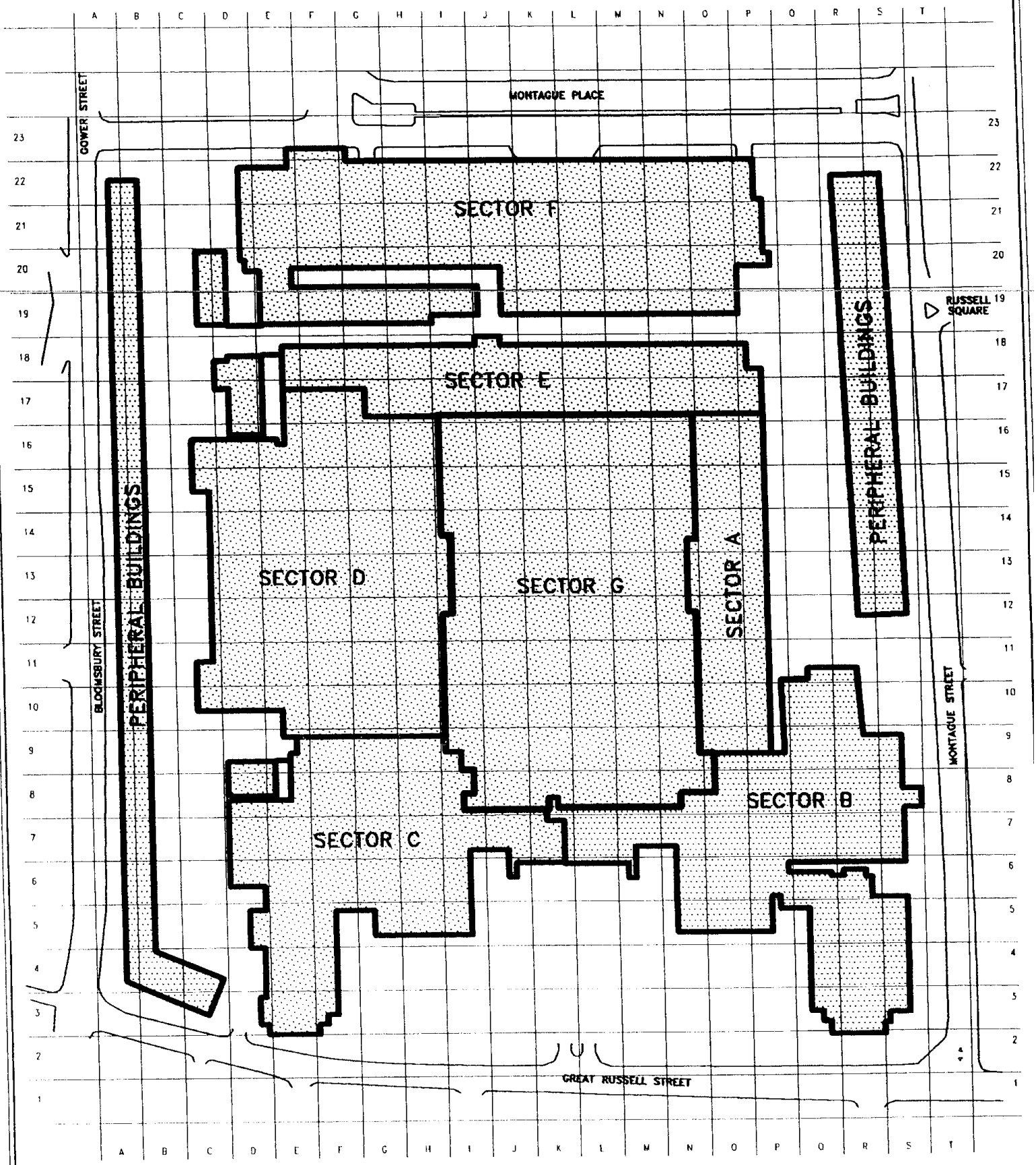
Mcl. Drg No 151950/M512

Scale: 1:750

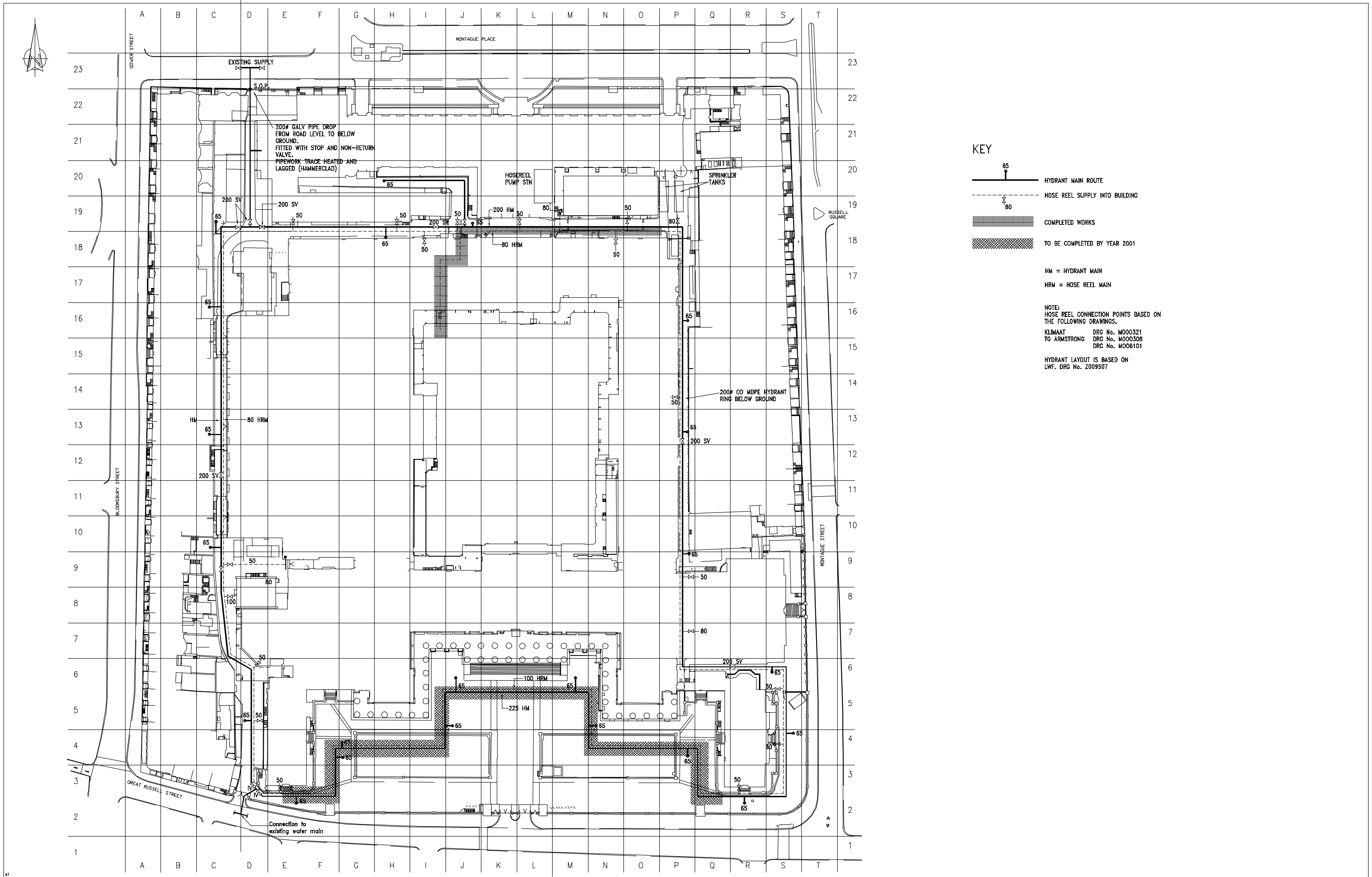
Drawn AK Des Chk Dwg Chk Approved
Date 14:11:97 Date Date Date

Title: MECHANICAL HARMONISATION SITE BOUNDARY FOR SOUND LEVEL CALCULATIONS

Drawing No. M000026 Rev.



THE BRITISH MUSEUM ©THE BRITISH MUSEUM.	Drawn SPB Date 19:05:00 Check Date 23.5.00 Appr Date 23.5.00		Rev
	BRITISH MUSEUM GRAPHICAL LAYOUT SECTORS A–G	SITE PLAN AND SECTOR BOUNDARIES	Drawing No. Z000121



Rev	Date	Modification	Alt	DO Chk	Orig Chk	App
A	6/4/98	REVISED SERVICES LAYOUT PUMPED HOSE REEL MAIN ADDED. DRAWING REVISED TO MATCH LWF LAYOUT		AK	WA	RWB
B	7/1/99	DRAWING REVISED TO SUIT KLIMAAT, TG ARMSTRONG AND LWF DRAWINGS	DRW	SPB	WA	RWB
C	30/3/00	REVISED TO INDICATE WORKS COMPLETED TO DATE	DRW			

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Drawn	DO Chk	Orig Chk	Approved
JSD	AK	RWB	RWB
Date 5.3.96	Date 5.3.96	Date 5.3.96	Date 5.3.96

Scale: NTS

Title: SITE SERVICES INFRASTRUCTURE OUTLINE LAYOUT OF HYDRANT MAIN AND HOSE REEL MAIN

Drawing No. M000003

Rev. C

APPENDIX H

ENGLISH HERITAGE/CAMDEN LIAISON PROCEDURE

Procedure for Planning Applications/Listed Building Consent (LBC)

1.0 Introduction

Occupying a Grade 1 Listed Building, it essential that the Museum meets the requirements for Planning Approval and Listed Building Consent. This procedure has been developed to ensure a common approach is followed for all BMD projects.

2.0 Procedure

2.1 To facilitate open dialogue with London Borough of Camden (LB of C) and English Heritage (EH) quarterly liaison meetings are held in J anuary, April, J uly and October at which all current and future projects at the Museums are discussed in outline. Matters discussed include the need for formal application, applications submitted and imminent, and informal submissions made/required to inform/clarify/supplement.

At the beginning of each project, the Museum Project Manager will notify APMP of the scale and scope to identify the need for statutory authority involvement/approval.

In general, all BMD projects that will be of interest to LB of C and EH will have been notified to the Head of P&PM by the BMD project representative for tabling at the quarterly meetings.

Some projects may benefit from a visit to site on the day of the liaison meeting accompanied by the P&PM Planner for informal consultation with EH/LB of C. If the outcome of the discussion suggests that a formal application is needed, then the designer will prepare this and submit it to Project Planner for final comments.

2.2 If the need for a submission is established, a draft package should be prepared by the designer and submitted to Project Planner. Typically, the package should comprise of:

- Draft application Form (if appropriate + enclosures eg
- Drawings/sketches showing proposed new including plans and elevations
- Photographs of existing situations with cross reference to drawings
- Location plan
- Manufacturer's literature with photos of equipment/fitments.
- Noise level of plant if applicable

The designer will update the package to incorporate comments and submit a revised package to Project Planner who will pass it to the Head of P for signature and submission.

The Project Planner will copy the complete submission and the response to AP&MP.

Consultants/contractors should not make direct contact with the London Borough of Camden or English Heritage without express permission. The project team must allow adequate time for liaison with and applications to the various authorities, which must be included within the project programme, to ensure that **no** works are started without the necessary permissions.

APPENDIX I

List of Infrastructure Documentation

THE BRITISH MUSEUM
Building Management Department

Planning & Project Management Section

MECHANICAL INFRASTRUCTURE SYSTEM DOCUMENTATION - AVAILABLE

SECTOR	DESCRIPTION OF DRAWING/DOCUMENT	REV.	DRAWING/DOCUMENT NO.	DATE	CONSULTANT	REMARKS
A	M&E Services FSD	-	-	00.03.95	F. C. Foreman & Ptnrs	
B	M&E Services FSD	-	-	00.03.95	W. S. P	
B	Level 6 Mechanical Services Record Drawings (3 of 3)	A	M 002077	02.08.00	T. G. Armstrong	
B	Level 6 Mechanical Services Record Drawings (2 of 3)	A	M 002076	03.08.00	T. G. Armstrong	
B	Level 6 Mechanical Services Record Drawings (1 of 3)	A	M 002075	03.08.00	T. G. Armstrong	
B	Level 5 Mechanical Services Record Drawings (3 of 3)	A	M 002074	03.08.00	T. G. Armstrong	
B	Level 5 Mechanical Services Record Drawings (2 of 3)	A	M 002073	03.08.00	T. G. Armstrong	
B	Level 5 Mechanical Services Record Drawings (1 of 3)	A	M 002072	03.08.00	T. G. Armstrong	
B	Level 4 Mechanical Services Record Drawings (3 of 3)	A	M 002071	03.08.00	T. G. Armstrong	
B	Level 4 Mechanical Services Record Drawings (2 of 3)	A	M 002070	03.08.00	T. G. Armstrong	
B	Level 4 Mechanical Services Record Drawings (1 of 3)	A	M 002069	03.08.00	T. G. Armstrong	

B	Level 3 Mechanical Services Record Drawings (3 of 3)	A	M 002068	03.08.00	T. G. Armstrong	
B	Level 3 Mechanical Services Record Drawings (2 of 3)	A	M 002067	03.08.00	T. G. Armstrong	
B	Level 3 Mechanical Services Record Drawings (1 of 3)	A	M 002066	03.08.00	T. G. Armstrong	
B	Level 2 Mechanical Services Record Drawings (3 of 3)	A	M 002065	03.08.00	T. G. Armstrong	
B	Level 2 Mechanical Services Record Drawings (2 of 3)	A	M 002064	03.08.00	T. G. Armstrong	
B	Level 2 Mechanical Services Record Drawings (1 of 3)	A	M 002063	03.08.00	T. G. Armstrong	
B	Level 1 Mechanical Services Record Drawings (3 of 3)	A	M 002062	03.08.00	T. G. Armstrong	
B	Level 1 Mechanical Services Record Drawings (2 of 3)	A	M 002061	03.08.00	T. G. Armstrong	
B	Level 1 Mechanical Services Record Drawings (1 of 3)	A	M 002060	03.08.00	T. G. Armstrong	
C	Level 2a Mechanical Services Record Drawings (1of 1)	-	M 003056	31.08.00	T. G. Armstrong	
C	Level 3 Mechanical Services Record Drawings (1 of 3)	-	M 003057	31.08.00	T. G. Armstrong	
C	Level 3 Mechanical Services Record Drawings (2 of 3)	-	M 003058	31.08.00	T. G. Armstrong	
C	Level 3 Mechanical Services Record Drawings (3 of 3)	-	M 003059	31.08.00	T. G. Armstrong	
C	Level 4 Mechanical Services Record Drawings (1 of 3)	-	M 003060	31.08.00	T. G. Armstrong	
C	Level 4 Mechanical Services Record Drawings (2 of 3)	-	M 003061	31.08.00	T. G. Armstrong	
C	Level 4 Mechanical Services Record Drawings (3 of 3)	-	M 003062	31.08.00	T. G. Armstrong	
C	Level 5 Mechanical Services Record Drawings (1 of 3)	-	M 003063	31.08.00	T. G. Armstrong	

C	Level 5 Mechanical Services Record Drawings (2 of 3)	-	M 003064	31.08.00	T. G. Armstrong	
C	Level 5 Mechanical Services Record Drawings (3 of 3)	-	M 003065	31.08.00	T. G. Armstrong	
C	Level 6 Mechanical Services Record Drawings (1 of 3)	-	M 003066	31.08.00	T. G. Armstrong	
C	Level 6 Mechanical Services Record Drawings (2 of 3)	-	M 003067	31.08.00	T. G. Armstrong	
C	Level 6 Mechanical Services Record Drawings (3 of 3)	-	M 003068	31.08.00	T. G. Armstrong	
C	Level 6a Mechanical Services Record Drawings (1 of 1)	-	M 003069	31.08.00	T. G. Armstrong	
D	M&E Services FSD	-	-	00.06.95	Hoare Lea & Ptnrs	
F	Roof Level Mechanical Services Record Drawings (2 of 2)	-	M 006172	29.02.00	T. G. Armstrong	
F	Roof Level Mechanical Services Record Drawings (1 of 2)	-	M 006171	29.02.00	T. G. Armstrong	
F	Level 7 Mechanical Services Record Drawings (1 of 1)	-	M 006170	29.02.00	T. G. Armstrong	
F	Levels 6b+c Mechanical Services Record Drawings (1 of 1)	-	M 006169	29.02.00	T. G. Armstrong	
F	Level 6a Mechanical Services Record Drawings (2 of 2)	-	M 006168	29.02.00	T. G. Armstrong	
F	Level 6a Mechanical Services Record Drawings (1 of 2)	-	M 006167	29.02.00	T. G. Armstrong	
F	Level 6 Mechanical Services Record Drawings (2 of 2)	-	M 006166	29.02.00	T. G. Armstrong	
F	Level 6 Mechanical Services Record Drawings (1 of 2)	-	M 006165	29.02.00	T. G. Armstrong	

F	Levels 5a+b Mechanical Services Record Drawings (1 of 1)	-	M 006164	29.02.00	T. G. Armstrong	
F	Level 5 Mechanical Services Record Drawings (2 of 2)	-	M 006163	29.02.00	T. G. Armstrong	
F	Level 5 Mechanical Services Record Drawings (1 of 2)	-	M 006162	29.02.00	T. G. Armstrong	
F	Level 4 Mechanical Services Record Drawings (2 of 2)	-	M 006161	29.02.00	T. G. Armstrong	
F	Level 4 Mechanical Services Record Drawings (1 of 2)	-	M 006160	29.02.00	T. G. Armstrong	
F	Level 3 Mechanical Services Record Drawings (2 of 2)	-	M 006159	29.02.00	T. G. Armstrong	
F	Level 3 Mechanical Services Record Drawings (1 of 2)	-	M 006158	29.02.00	T. G. Armstrong	
F	Level 2 Mechanical Service Record Drawings (2 of 2)	-	M 006157	29.02.00	T. G. Armstrong	
F	Level 2 Mechanical Service Record Drawings (1 of 2)	-	M 006156	29.02.00	T. G. Armstrong	
F	Level 1a Mechanical Services Record Drawings (2 of 2)	-	M 006155	29.02.00	T. G. Armstrong	
F	Level 1a Mechanical Services Record Drawings (1 of 2)	-	M 006154	29.02.00	T. G. Armstrong	
F	Level 1 Mechanical Services Record Drawings (2 of 2)	-	M 006153	29.02.00	T. G. Armstrong	
F	Level 1 Mechanical Services Record Drawings (1 of 2)	-	M 006152	29.02.00	T. G. Armstrong	
F	Sub-Base (E) Mechanical Services Record Drawings (1of 1)	-	M 006151	29.02.00	T. G. Armstrong	
F	Sub-Base (W) Mechanical Services Record Drawings (1of 1)	-	M 006150	29.02.00	T. G. Armstrong	
F	M&E Services FSD	-	-	00.11.95	T. G. Armstrong	
ALL	Feasibility Report for development of 2 Energy Centres	-	-	00.07.96	McLellan & Partners	

THE BRITISH MUSEUM
Building Management Department

Planning & Project Management Section

MECHANICAL INFRASTRUCTURE SYSTEM DOCUMENTATION – AVAILABLE

All	Building Services Survey – Mechanical	-	Vol 1 & 2	July 93	Hoare Lea	
A&D	Level 1 Services Floor Duct Survey	A	-	Jan.97	Buro Happold	
B&C	Level1 Services Floor Duct Survey	A	-	May 97	Buro Happold	
E	Level1 Services Floor Duct Survey	A	-	May 97	Buro Happold	
ALL	Review of Heating Infrastructure	-	-	June 2001	McLellan	
-	Survey of M&E Services in the Bindery	-	-	June 98	TG Armstrong	
B,C,D	Feasibility Report for Heating Re-structuring	-	-	Jan 2000	T G Armstrong	
ALL	Options for upgrade of BMS Front End	-	-	May 2001	Klimmaat	

THE BRITISH MUSEUM
Building Management Department

Planning & Project Management Section

MECHANICAL INFRASTRUCTURE SYSTEM DOCUMENTATION - INTENDED

SECTOR	DESCRIPTION OF DRAWING/DOCUMENT	REV.	DRAWING/DOCUMENT NO.	DATE	CONSULTANT	REMARKS
A	Level 1 - Mechanical Services Layout					
A	Level 2 - Mechanical Services Layout					
A	Level 6 - Mechanical Services Layout					
A	Roof - Mechanical Services Layout					
D	Level 1 - Mechanical Services Layout					
D	Level 2 - Mechanical Services Layout					
D	Level 6 - Mechanical Services Layout					
D	Roof - Mechanical Services Layout					