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# **London Coliseum Refurbishment Project**

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## **Building Services Operation and Maintenance Manual**

### **Book 1 Volume 1**

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### 3.1 Description of the System

A dedicated air handling unit (AHU01) and ductwork system serves the Kitchen at Kitchen Mezzanine level.

Fresh air is introduced at roof level via a weather louvre (L1) and passes through a duct attenuator (AT01), designed to reduce the emission of plant noise to the outside. The fresh air then enters the air handling unit and passes through the following components:

- Motorised Intake Damper
- Bag Filter
- Heat Recovery Thermal Wheel
- Supply Fan with Inverter Drive

The air is then discharged from the unit to pass through a duct mounted attenuator (AT03), designed to reduce duct-borne noise transmission from the air handling plant. Ductwork is then routed from the roof plant area to the kitchen where the air is issued through the supply air grilles (SGxx).

Extract air is drawn through the kitchen canopy (installed by the catering contractor) and then routed to the roof through ductwork to an attenuator (AT04), designed to reduce duct-borne noise transmission from the air handling plant. The air is then drawn into the extract part of the air handling unit and passes through the following components:

- Bag Filter
- Heat Recovery Thermal Wheel
- Extract Fan with Inverter Drive
- Motorised Shut-off Damper

From the air handling unit the air passes through an exhaust attenuator (AT02), designed to reduce the emission of plant noise to the outside, and then exhausted to atmosphere through a stainless steel roof cowl.

Heat recovery is achieved within the air handling unit by the incorporation of a Thermal Wheel, which comprises a rotating regenerative air to air heat recovery unit that transfers the heat within the exhaust air to the supply air stream.

To provide variable air volume to the system the supply and extract fan motors in the air handling unit are connected to Inverter Drives.

A purpose made acoustic enclosure has been installed around the air handling unit to maintain the specified external noise level from plant on the roof. The enclosure has been constructed from 100mm thick double skin panelling with insulation sandwiched between the two panel skins.

Volume control dampers have been installed within the ductwork system to provide air flow balance control. These dampers have been adjusted and secured during the system commissioning stage.

### 3.2 Equipment

Asset Code.	Item	Location
AHU01	Air Handling Unit	Roof
L1	Fresh Air Intake Louvre	Roof
AT01	Fresh Air Attenuator	Roof
AT02	Exhaust Air Attenuator	Roof
AT03	Supply air Attenuator (Job side)	Roof
AT04	Extract air Attenuator (Job side)	Roof
SG	Supply air grilles	Kitchen Store
SG	Supply air grilles	Kitchen

### 3.3 Associated Drawings

Drg. No.	Title
M/033	Ventilation Services Schematic
M/Series	Layout drawings - refer to schedule in 1.9

### 3.4 Dependencies

Service/Plant	Dependent on
Fan Motors, Thermal Wheel	Electrical supply
Plant Operation	BMS

## 3.5 Operation

A specialist BMS/Controls contractor has prepared a detailed operation manual and this should be referred to for all plant control and settings information for the system.

The following is an outline of basic system operation.

### 3.5.1 General

An integrated controls system has been supplied by the air handling unit manufacturer and provides the following functions:

- Time control
- Air flow control
- Temperature regulation
- Alarm functions
- Cooling functions
- LON interface to BMS system
- Control display

Normal control is from the BMS and a local hand-held controller located at the AHU. The hand-held controller should only be used where communications between the BMS and AHU have failed.

Full details of the unit integral control system are located in the PM Luft Operating & Maintenance Instructions for the GOLD Air Handling Unit located within the Manufacturers Literature section of this manual.

Control equipment associated with the AHU is housed in Motor Control Centre MCC3.

### 3.5.2 Preparation for Start-up

Prior to putting the air handling plant back into service following prolonged shutdown or maintenance, the following points should be observed as necessary:

- a. Inspect the AHU and clean out any accumulation of dust, dirt and debris.
- b. Manually rotate fans to ensure free running.
- c. Inspect fan motors for unobstructed ventilation grilles and general cleanliness.
- d. Check security and condition of electrical connections.
- e. Check overload settings with motor nameplates.
- f. Ensure all guards where fitted are in position and secure.
- g. Check air filters are correctly seated in frames and are secure.
- h. Momentarily run each fan in HAND position to ensure direction of rotation is correct. Check for unusual operation, excessive vibration, or noise.
- i. When it has been confirmed that the system is safe to operate, select AUTO at the control panel.

### **3.5.3 Normal System Start/Stop**

The system is started and stopped by the BMS fixed time programme unique to this AHU or by manual user interface.

### **3.5.4 Emergency Shutdown**

The system may be stopped by the manual user interface or at the MCC.

### **3.5.5 Fire Interlock Control**

The plant is hardwired interlocked with the buildings Fire Detection and Alarm System and Fireman's Override Control Panel.



### 3.6 Maintenance

The following maintenance tasks and frequencies are as recommended by the HVAC Standard Maintenance Specification Volumes 1 to 5 (where applicable), supplemented where available by manufacturers' instructions. It is assumed that maintenance work will be carried out by competent engineers with the appropriate tools and relevant experience. Where specialist equipment is involved a maintenance agreement with the manufacturer or installer is recommended. Manufacturers' recommendations should always be followed where provided.

Before undertaking any maintenance work the relevant authority must be advised and the necessary precautions taken, e.g. carry out risk assessment, isolate supplies, post notices, issue permits to work, etc. All work must be carried out in accordance with Health and Safety requirements and in a manner which does not place others at risk.

Item	Frequency	Task/Action
Air Handling Units	-	Reference should be made to the manufacturer's maintenance recommendations that are contained in the "PM Luft Operating & Maintenance Instructions Manual for GOLD Air Handling Units" located within the Manufacturers Literature section of this manual.
	Weekly	General check on overall condition. Carry out complete operational check for all components. Check access doors are correctly fitted and secured. Generally inspect for any problems, including noise, sealing, etc.
	6 Monthly	Inspection/cleaning/lubrication of fan in accordance with the manufacturer's recommendations. Minimum requirements for this should include:- <ul style="list-style-type: none"> <li>• Check all nuts, bolts, etc., for security.</li> <li>• Check fan bearings for noisy operation and visual signs of overheating.</li> <li>• Clean all surfaces, particularly fan impeller and motor casing ventilation louvres.</li> <li>• Check condition and security of electrical connections.</li> </ul> Replace main filters 6 monthly, or before if the manufacturer's recommended pressure drop is exceeded.

**Maintenance continued...**

Item	Frequency	Task/Action
Air Handling Units (Cont'd)	Annually	<p>Inspect thermal wheel for dust/dirt build-up, clean as recommended taking care not to damage. <b><i>Do not let dirt accumulate.</i></b></p> <p>Check condition of motorised damper pivots and linkages, clean as required. Check for satisfactory operation.</p> <p>Overhaul fan/motor and AHU components as found necessary. Where lubrication is required the intervals should be assessed in conjunction with the manufacturer's recommendations relating to hours run.</p>
Ductwork	Annually	<p>General inspection of ductwork and associated equipment should include:-</p> <ul style="list-style-type: none"> <li>• Checking for any damage, loose supports and suspensions, etc.</li> <li>• Clean and lightly lubricate (as appropriate) damper pivots and linkages. Return to "as commissioned" positions.</li> <li>• Inspect ductwork insulation for any damage; repair as necessary to same specification.</li> <li>• Clean grilles/diffusers</li> <li>• The course of any stagnant water and wet areas in ductwork must be determined and eliminated.</li> </ul>
Attenuators		<p>There are no maintenance procedures required for this item of equipment</p>

### 3.7 Specifications

#### 3.7.1 Air Handling Unit (AHU01)

Manufacturer/Supplier ..... P M Luft  
 Model ..... GOLD 22

##### Supply Air Handling Unit

Intake Damper: ..... Supplied

##### Filter

Bag Filter: ..... Eurovent 4/5

##### Heat Recovery

Type: ..... Thermal Wheel

Air Entering Temperature (°C): ..... -4

Air Volume (m<sup>3</sup>/s): ..... 0.65

Max. Air Side PD (Pa): ..... 70

Minimum Temp. Efficiency (%): ..... 83

##### Supply Fan

Type: ..... Direct

Drive Type: ..... Inverter

Air Volume (m<sup>3</sup>/s): ..... 0.65

External Static Pressure (Pa): ..... 400

Electric Supply (v/ph/Hz): ..... 400/3/50

Motor Size (kW): ..... 1.1

##### Extract Air Handling Unit

##### Filter

Bag Filter: ..... Eurovent 4/5

##### Heat Recovery

Type: ..... Thermal Wheel (Refer to supply AHU above)

##### Extract Fan

Type: ..... Direct

Drive Type: ..... Inverter

Air Volume (m<sup>3</sup>/s): ..... 0.65

External Static Pressure (Pa): ..... 400

Electric Supply (v/ph/Hz): ..... 400/3/50

Motor Size (kW): ..... 1.1

Shut-off Damper: ..... Supplied

Air Handling Acoustic Requirements

<b>Octave Band Frequency</b>	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
Max. in duct Sound Power Level (Lw db re10 <sup>-12</sup> W	76	66	59	76	72	75	75	67

**3.7.2 AHU Plantroom Enclosure**

Manufacturer: ..... Allaway Acoustics  
 Construction: ..... 100mm Double Skin c/w insulation  
 Size (mm):..... 5600L x 5000W x 2500H

**3.7.3 Attenuators (AT01 to AT04)**

Manufacturer/Supplier ..... Allaway Acoustics  
 Air Volume (m<sup>3</sup>/s):..... 0.65  
 Max. Pressure Drop (Pa): ..... 30  
 Duct Size (mm): ..... 400 x 400  
 Max. Length (mm):..... 1600

<b>Octave Band Mid Frequency</b>	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
<b>Attenuator Reference</b>	<b>Min. Installed Insertion Loss (db) (In-duct Sound Power Fan Side of Attenuator)</b>							
AT01	8	15	26	40	55	39	30	18
AT02	9	16	24	36	44	28	21	13
AT03	8	15	26	40	55	39	30	18
AT04	9	16	24	36	44	28	21	13

**3.7.4 Fresh Air Intake Louvre (L1)**

Manufacturer: ..... Trox  
 Air Volume (m<sup>3</sup>/s):..... 0.65  
 Nominal Size (mm): ..... 700 x 700  
 Minimum Free Area (%):..... 50  
 Pressure Drop (Pa): ..... 30  
 Noise Level @ 1m: ..... 40  
 Finish: ..... RAL colour

### 3.8 Manufacturers' Literature

The following literature associated with the services outlined in this section has been provided:

Manufacturer/Supplier	Literature	Location
Allaway Acoustics Ltd	Paroc Slab Technical Data Sheets Certified Drawing A02 Issue A ( AT01 - 37) Certified Drawing A10 Issue B ( AT038 & 039)	Book 2 Volume 1 Section 1
P. M. Luft	Operating & Maintenance Instructions for GOLD Air Handling Unit, Sizes 11 - 32 Version B	Book 2 Volume 2 Section 18
TROX Brothers Ltd	Weather Resistant Louvres Type WG - AWG - WGE - AWK - WG.F Data Brochure Grilles Type AR - AE (for return air) Data Brochure	Book 2 Volume 3 Section 26

### 3.9 Spares

During the preparation of this manual manufacturers were requested to provide recommendations for the type and quantity of spare parts to be held for the equipment supplied. Where this information has been provided it is listed below.

Item	Man/Supplier	Part No.	Part	Qty
Air Handling Unit	P. M. Luft	TBFZ-1-01-20-7	Filter	1 set

## **3.10 Schedules**

### **3.10.1 Supply Grilles**

Refer to AHU01 test documentation in Book 3 Volume 2.

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## 22.1 Description of the System

### 22.1.1 General

The following LV switchgear has been installed:-

- Main LV Switchboard SP1
- Extension to existing FOH LV Switchboard SP2
- Extension to existing BOH LV Switchboard SP3
- Stage Equipment LV Switchboard SP4

The LV switchgear serves new and existing switchpanels, distribution boards, stage lighting and equipment, and mechanical services as indicated on the electrical schematic drawings.

General and feature lighting and small power circuits are derived from distribution boards as indicated in the schedules.

### 22.1.2 LV Switchboard SP1

A new main LV switchboard is installed in the BOH switchroom at basement level.

The switchboard is protected by a 1250A TP&N air circuit breaker (ACB) fed from transformer Tx1 and includes 2 No. 630A MCCBs serving the FOH and BOH switchboards respectively. The electrical supply for the fire alarm control panels and the emergency lighting central battery unit are also derived from this switchboard.

The incoming supply is monitored by a multimeter in the incoming supply section which provides the following readings:-

- Voltage Phase / Phase and Phase / Neutral
- Current, each phase and neutral
- kW, kVAr, kVA
- Power factor
- Frequency
- kWh and pulse output

Space is included within the switchboard for active harmonic filtering.

Power factor correction (PFC) equipment is provided and comprises 8 No. 25 kVAr stages. Each capacitance stage is complete with one set of three-phase control fuses, triple-pole contactor and suitably rated capacitor bank. The total capacitance of the system is isolated from the LV busbars by means of a suitably rated MCCB. In addition, a multi-stage control relay is supplied to provide remote indication of the power factor. An empty cubicle is provided for retrospective fitting of power factor de-tuning reactors at a later date if required.

The main incoming circuit breaker is triple-pole and bolted neutral, manually operated, spring assisted, withdrawable pattern complete with integral overcurrent and short circuit protection, to BS EN 60947-2 1996.



Moulded case circuit breakers are triple-pole and bolted neutral, fixed pattern, independent, manually closing air break type and are generally operated by means of a door interlocked rotary handle. MCCBs up to and including 250A are fitted with thermal and magnetic trips providing overcurrent and short circuit protection having a utilisation category A. MCCBs above 250A are fitted with solid state integral overcurrent and short circuit protection having a utilisation category B. All MCCBs are housed in their own individual sheet steel enclosure and comply with BS EN 60947-2 having a breaking capacity of 50 kA.

Busbars are air insulated, totally enclosed, rectangular section, hard drawn, high conductivity copper, ASTA certified for a fault range of 50 kA for one second. The neutral busbar is the same cross-section as the phase busbars.

An earth bar running the full length of the switchboard is provided.

### **22.1.3 FOH and BOH Switchboards SP2 and SP3**

The existing switchboards located in the FOH and BOH switchrooms have been refurbished and extended by means of an additional cubicle. The existing 800A fuseswitch has been replaced with a new 800A incoming isolator, and the outgoing fuseswitches have been replaced. Existing voltmeters and ammeters have been retained.

The new cubicle is constructed to BS EN 60439-1 and is suitable for rear access, with cables entering / leaving from the top and bottom as required.

Fuse switches are flush cubicle mounting pattern with retractable operating handles and removable switch carriage for fuse replacement and contact inspection, the fixed contacts being fully shrouded. Interlocks are provided to prevent opening of the front cover in the ON position, and closing the switch with the front cover open. Mechanical flag-type indicators, driven by the moving portion of the switch clearly show the ON and OFF positions. Each fuseswitch has provision for padlocking in the OFF position.

### **22.1.4 LV Switchboard SP4**

A new dedicated stage equipment switchboard has been installed in the new stage switchroom / dimmer room at kitchen mezzanine level.

The switchboard is protected by an incoming 1250A TP&N ACB fed from transformer Tx2 and is provided with numerous outgoing ways as shown on the drawings. The switchboard is similar in specification and construction to SP1 and includes PFC equipment, etc. as described above.

### **22.1.5 LV Distribution**

Existing cables together with their respective containment have been re-routed and re-terminated as required to suit the revised switchgear locations.

Outgoing cables from the switchboards feed new and existing distribution panels, distribution boards, lifts, mechanical plant, etc. as shown on the drawings. Generally, all new cables are XLPE/SWA/LSF run on cable ladder /tray. Supplies

and sub-circuits feeding life safety equipment such as disabled evacuation lifts, fire alarms, emergency lighting, etc. is wired in heavy duty MICC with an LSF sheath.

A complete trunking and conduit system serving all lighting, power, fire alarms, security, telephone, mechanical equipment, controls, etc. has been installed as shown on the layout drawings. The installation is surface mounted in plant rooms, stage, flytower and general BOH storage areas. Elsewhere the installation is concealed by running in ceiling voids where possible, or chased in ceilings, walls and floors. Particular care was taken in listed areas to ensure the existing fabric finish was reinstated.

All trunking is galvanised and cable tray is heavy duty return flange type. Surface run conduit in plantrooms and external runs are galvanised. Concealed conduit is black enamel finish.

Distribution boards comprise an internal incoming isolator and outgoing type C miniature circuit breakers (MCBs).

### **22.1.6 Alternative Lift Supplies**

There are three lifts within the building as follows:-

- FOH L1 - Passenger Lift
- FOH L2 - Catering Lift
- BOH L1 - Goods Lift

The electrical supply to each lift is derived from a dedicated automatic changeover switch (ACS) fed from two sources, in order to provide an alternative supply in the event of normal supply failure.

Normal supplies are derived from SP2 (FOH L1 & 2) and SP3 (BOH L1), cabled directly from the switchboard onto the ACS and thence to the relevant lift isolator. The alternative supplies are taken from panelboard ALS1 which derives its supply directly from an REC intake (formerly the chiller supply).

ALS1 has a 200A MCCB incomer and a suitably rated outgoing MCCB for each lift supply. Each outgoing supply is connected to the appropriate ACS and is available should the normal supply fail.

### **22.1.7 50 Brydges Place Supply**

The existing REC 200A TP&N incomer and meter has been relocated. A new 200A TP&N MCCB incomer has been installed serving a new 12-way TP&N MCB distribution board, which provides general lighting and power circuits for the building.

### **22.1.8 Small Power Installation**

Switched socket outlets, fused connection units, isolators and other accessories are provided throughout the building as shown on the drawings.

Generally, wiring is carried out using single core LSF sheathed cables run in conduit and trunking. The installation is surface run in plantrooms and stores, etc., and concealed elsewhere.

Socket outlets with RCD protection are rated at 30 mA. Accessories are generally selected from the MK Electric 'Logic Plus' range, with Metalclad units in plant areas. FOH decorative areas are fitted with MK 'Edge' accessories finished in antique bronze.

### **Bar and Catering Areas**

Dedicated distribution boards have been provided to enable the services within these areas to be wired by the contractor during fit-out works. The relevant distribution boards are identified in the schedule at the end of this section.

### **Power Supplies**

Desk outlets are provided, integrated as part of the box office and stage door design.

Additional power supplies include fused connection units for the following services:-

- Security control equipment
- Disabled refuge alarm
- Disabled toilet alarm
- Induction loops
- Magnetic door holders
- Voice alarm panels
- Telephone exchange panel
- BMS equipment

### **Dressing Rooms**

Each dressing room is provided with a main incoming fused 20A double-pole keyswitch, a single 30 mA RCD protected switched socket outlet, a 110/230V shaver socket, a single gang light switch and a number of 7W low energy dressing table lamps with ES cap.

### **Office Areas**

Floor outlets are provided in the management office at balcony level. 3-compartment trunking is provided in various offices, either skirting or dado mounted, for subsequent wiring by others, e.g. IT, telecoms, etc.

### **Auditorium and Stage**

Recessed mounted cleaners' sockets are provided throughout the auditorium as shown.

The lighting and power installation for the auditorium and stage areas is described separately.

## 22.2 Equipment

Asset Code	Item	Location
SP1	Main LV Switchboard	Basement
SP2	FOH Switchboard	Basement
SP3	BOH Switchboard	Basement
SP4	Theatre Switchboard	Kitchen Mezzanine
DBx	Distribution Boards	See schedule in 22.10
ALS1	Lift Supply Panelboard	
C/O1	Automatic Changeover Switch FOH L1	
C/O2	Automatic Changeover Switch FOH L2	
C/O3	Automatic Changeover Switch BOH L1	

## 22.3 Associated Drawings

Drg. No.	Title
E/002 to 009	Electrical schematics
E/300 Series	Small power layouts

## 22.4 Dependencies

Service/Plant	Dependent on
General power and lighting	24/Seven HV supply to Tx1
Stage power and lighting	24/Seven HV supply to Tx2

## 22.5 Operation

### 22.5.1 Normal Operation

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**Note. Switching operations should only be carried out by qualified electrical engineers.**

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During normal operation all main circuit breakers should be closed in order to provide electrical power to the main and sub-main distribution equipment. It should only be necessary to isolate the supply to redundant circuits, or when service is required.

All switching operations are manual. REC supplies are provided to switchboards SP1 and SP4 via the 24/Seven transformers via the ACB on each switchboard, and to other intakes (refer to HV Supply). Opening the ACB on a switchboard will isolate all the services fed by the respective board, including life safety services. Refer to the ABB instructions in Book 2 for details of ACB operation.

Specific services and distribution boards may be isolated by opening the relevant MCCB / Fuseswitch. Details of circuits served are shown on the charts within the switchrooms.

### 22.5.2 Shutdown

It should not be necessary to shutdown supplies other than for service.

### 22.5.3 Emergency Shutdown

A supply can be isolated in an emergency by opening the relevant circuit breaker, assuming the circuit has not tripped automatically. Individual circuits are isolated at the distribution board via the MCB, or all circuits can be isolated by opening the incoming circuit breaker.

Where a service has two separate supplies, such as the lift supplies, both supplies must be isolated before commencing work.

## 22.6 Maintenance

The following maintenance tasks and frequencies are as recommended by the HVAC Standard Maintenance Specification Volumes 1 to 5 (where applicable), supplemented where available by manufacturers' instructions. It is assumed that maintenance work will be carried out by competent engineers with the appropriate tools and relevant experience. Where specialist equipment is involved a maintenance agreement with the manufacturer or installer is recommended. Manufacturers' recommendations should always be followed where provided.

Before undertaking any maintenance work the relevant authority must be advised and the necessary precautions taken, e.g. carry out risk assessment, isolate supplies, post notices, issue permits to work, etc. All work must be carried out in accordance with Health and Safety requirements and in a manner which does not place others at risk.

Item	Frequency	Task/Action
LV Switchgear	Weekly	Carry out a visual inspection of the switchrooms and switchpanels. If any malfunctions occur, investigate and correct the cause. Check condition of rubber matting and switchroom ancillaries.
	Annually	Check operation of ACBs, MCCBs and fuseswitches and carry out any necessary operational and safety checks. ACBs should be inspected in accordance with the manufacturer's instructions which may necessitate withdrawing the unit from its housing and examining the arc chutes, contacts, etc. Check all switchpanel connections for adequate air clearance between phases and to earth. Carry out any specific maintenance and lubrication of switchgear in accordance with manufacturers' instructions. Check terminations for tightness of bolts and for heat build up at contacts caused by wear.
PFC Equipment	Annually	Refer to Manufacturers Manuals. Inspect for external drainage or deterioration. Carefully, observing all safety precautions, isolate and discharge the capacitors. (This operation should only be carried out at times of low electrical load otherwise the uncorrected power factor may reach a value where considerable expense is incurred by the consumer). Check internal terminals and connections and inspect capacitors for any bulging, indicating dangerous condition. Measure and record insulation resistance of capacitor to earth. Check condition and operation of contactor assembly. Check operation of control relay and record power factor of system.

## Maintenance continued...

Item	Frequency	Task/Action
Fuseswitches	Annually	Remove old grease from fixed and moving contacts and re-apply a smear of good quality electro-mechanical lubricating grease. Check for tightness of screws and nuts securing fuses, fixed contact housings and moving contact assemblies. Ensure that the unit operates in a smooth manner.
Distribution Boards	Annually	General inspection and status check. Look for build-up of dust internal and clean out as necessary. Check operation of incoming isolator and MCB switches. Check circuit chart is up to date. Confirm all MCB sizes are correct. <b>CAUTION:</b> Carry out inspection and testing to the 16 <sup>th</sup> Edition of the IEE Electrical Wiring Regulations of the entire LV installation. <b>GENERAL NOTE:</b> Maintenance of switchgear must be carried out in accordance with BS6423 1983 (plus amendments).
Socket Outlets	Annually	Routine inspection for damage and operation. Check plug tops for signs of overheating; if apparent, check connected load of the appliance or equipment. Check flexible cables from plugs for signs of damage or stress on terminals and correct as required.
Fused Connection Units	Annually	Routine inspection for damage and operation. Check that outgoing cables to the connected appliance equipment are free from damage and securely connected.
Isolators / Switches	Annually	Routine inspection for damage and operation. Check for evidence of dust or contamination on insulating surfaces and for signs of discolouration due to the effects of overheating. Check all cables are terminated correctly and are secure. Carry out functional operation to ensure switch mechanism operates.
Automatic Changeover Switch	Annually	Check operation of ACS units and carry out any necessary operational and safety checks. ACS units should be inspected in accordance with the manufacturer's instructions. Check terminations for tightness of bolts and for heat build up at contacts caused by wear.

## 22.7 Specifications

Item	Specification
Main LV Switchboard SP1	Manufacturer ..... ABB Low Voltage Systems Type..... MNS-BS Location..... Basement BOH Switchroom Supply ..... 400V 3 Ph 4W 50Hz Standard..... BS 60439-1 1994 Segregation ..... Form 4 Type 5 Fault level ..... 50 kA for 1 sec Busbars ..... 1600A per phase PFC ..... 200 kVAr (8 x 25 kVAr stages) Incomer ..... 1250A ACB Outgoing switches ..... MCCBs Cable access ..... Rear Cable entry / exit..... Top Protection ..... IP31 Finish..... RAL 7035 Light grey Dimensions (mm) ..... 2445W x 2300H x 1000D
LV Switchboard SP2	Manufacturer ..... ABB (extension to existing) Type ..... 1 No. Polar type extension cubicle Location..... Basement FOH Switchroom Supply ..... 400V 3 Ph 4W 50Hz Standard..... BS 60439-1 1994 Segregation ..... Form 4 Type 5 Fault level ..... 50 kA for 1 sec Busbars ..... 1250A per phase Outgoing switches ..... Fuseswitches Cable access ..... Rear Cable entry / exit..... Top / bottom Protection ..... IP31 Finish..... RAL 7035 Light grey Dimensions (mm) ..... 620W
LV Switchboard SP3	Manufacturer ..... ABB (extension to existing) Type..... 1 No. Polar type extension cubicle Location..... Basement BOH Switchroom Supply ..... 400V 3 Ph 4W 50Hz Standard..... BS 60439-1 1994 Segregation ..... Form 4 Type 5 Fault level ..... 50 kA for 1 sec Busbars ..... 1250A per phase Outgoing switches ..... Fuseswitches Cable access ..... Rear Cable entry / exit..... Top / bottom Protection ..... IP31 Finish..... RAL 7035 Light grey Dimensions (mm) ..... 620W



**Specifications continued...**

Item	Specification
LV Stage Switchboard SP4	Manufacturer ..... ABB Low Voltage Systems Type ..... MNS-BS Location ..... Kitchen Mezz. Plantroom Supply ..... 400V 3 Ph 4W 50Hz Standard ..... BS 60439-1 1994 Segregation ..... Form 4 Type 5 Fault level ..... 50 kA for 1 sec Busbars ..... 1600A per phase PFC ..... 200 kVAr (8 x 25 kVAr stages) Incomer ..... 1250A ACB Outgoing switches ..... MCCB / Fuseswitch Cable access ..... Rear Cable entry / exit ..... Top Protection ..... IP31 Finish ..... RAL 7035 Light grey Dimensions (mm) ..... 7095W x 2000H x 1000D
Alternative Lift Supply Panelboard	Manufacturer ..... Schneider Type ..... Merlin Gerin
Automatic Changeover Switch	Manufacturer ..... MEM Type ..... HL
Distribution Boards	Manufacturer ..... Schneider Type ..... Merlin Gerin Range ..... Isobar 4

## 22.8 Manufacturers' Literature

The following literature associated with the services outlined in this section has been provided:

<b>Manufacturer/Supplier</b>	<b>Literature</b>	<b>Location</b>
ABB	Operating and Maintenance Manual	Book 2 Volume 4 Section 1

## 22.9 Spares

No specific spares have been recommended, unless listed within the literature.

## 22.10 Schedules

### 22.10.1 Distribution Boards

Ref.	Level	Location	Function
B/LP1	Basement	FOH Switchroom	Lighting & Power
B/LP2	Basement	Pump Room	Lighting & Power
B/B	Basement	Dutch Bar	Services
D/BK	Basement	BOH Kitchen	Services
DB/A	Basement	Below Stage N	Lighting & Power
DB/B	Basement	Below Stage S	Lighting & Power
S/BO	Basement	Below Box Office	Box Office Power
S/LP1	Stalls	Kiosk Store	Lighting & Power
S/B1	Stalls	Bar	Services
S/B2	Stalls	Bar	Services
S/LXW	Stalls	Workshop	Services
M/K	Mezzanine	Kitchen	Services
DC/LP1	Dress Circle	Electrical Riser	Lighting & Power
DC/B	Dress Circle	Bar	Services
DC/K	Dress Circle	Kitchen	Services (by others)
R22N	Dress Circle	Kitchen Corridor	Dressing Room Power
UC/LP1	Upper Circle	Electrical Riser	Lighting & Power
UC/B	Upper Circle	Bar	Services
KM/K	Kitchen Mezz.	Kitchen	Services (by others)
F13	Kitchen Mezz.	Plantroom	Small Power
BA/LP1	Balcony	Electrical Riser	Lighting & Power
BA/B	Balcony	Bar	Services (by others)
R13	Balcony	Store	Small Power
R/EXT1	Tower Room	External	Lighting & Power
R/RPN	Roof	Pod North	Lighting & Power
R/RPS	Roof	Pod South	Lighting & Power
LMR DB	Roof	Lift L1 LMR	Lift Lighting & Power
50 BP	Basement	Brydges Place	Lighting & Power

**Note: The above schedule lists new distribution boards - existing distribution boards are shown on the electrical layout drawings.**