The British Museum

World Conservation and Exhibition Centre

Particular Specification - Electrical

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1 LIGHTING CONTROL

1.1.1 Lighting Control

1.1.1.1 System Description

A lighting control system shall be supplied, installed, tested and commissioned to serve the entire building.

This system shall be centrally controlled from a PC controller connected by low voltage bus to various controllers throughout the public areas of the building, each capable of stand-alone operation in the event of a central PC failure. The control protocol used shall be a KNX backbone with DALI. The control system shall be networked to allow control from any PC which shall perform two key functions:

System monitoring – all equipment shall be automatically monitored, and faults reported to the central PC.

Lighting control – it shall be possible to fully control and program the lighting control installation.

The lighting control system shall provide full flexibility, and allow each individual component to be individually addressed and switched and/or dimmed as required. It shall also provide an astronomical, 365-day timeclock to allow the lighting in various areas to be automatically controlled for normal hours of occupancy, with local manual override controls, where appropriate, for out-of-hours working.

Graphical user interfaces shall include floor plan layouts for each level indicating luminaries/zone status, ability to switch or dim any area, scheduling and fault monitoring. The contractor shall submit for approval a pro-type graphical user interface (which complements the overall building BMS) prior to installation.

The Lighting Control System shall be powered from a local UPS backed distribution board such that it remains operational during a mains failure condition.

The Lighting Control Contractor shall commission the system using these devices on circuits agreed with the Design Team.

Photocells be overridden by manual switches provided by the Electrical Contractor. The Electrical Contractor shall provide manual override and control switches on purpose made switch plates in each electrical switch-room and riser.

The lighting control systems shall allow the control of lighting in specific zones from control input and output devices. Addressed output devices shall switch and/or dim lighting circuits as required.

Addressed input devices shall control output devices. Activation of any input device shall allow activation of any or multiple groups of output devices anywhere in the building.

PIRs in toilet areas shall provide an output to the solenoid valve within the toilet area.

The system shall be capable of operating without a central/area processor connected, including the operation of all system wall switches, detectors, photoelectric/PIR's, etc. It is not acceptable for the logical relationship between input devices and output loads to be dependent on a central processor being connected.

Any failure of a module on the system shall not affect any other module on the system. All devices shall be able to communicate directly with each other without the need for a computer or a centrally based/floor processor to receive and transmit signals. During times of computer maintenance, full lighting control shall continue.

It shall be possible for a system module or additional control to be added or changed without powering down the control bus. No reconfiguration of existing units or network shall be required during any system reconfiguration. All existing units shall be left undisturbed.

No additional wiring or connections shall be required during reconfiguration. The control network shall automatically recognize new control modules.

The system shall have a failsafe default mode and default to an 'on' state upon power or system failure. Modules shall be able to be programmed to re-start to 'on', 'off', or resume in previous state after power or system failure.

The system shall have a software controlled network structure. Any input device shall be able to control any output device, or any group of devices. The devices shall be able to be located anywhere on the network without a direct connection. It shall be possible to change the relationship of devices at any time, without re-wiring. The system shall have distributed intelligence to allow full control over any module even if on another electrical sub-system.

The system shall be able to be programmed to perform logic functions if required. Allowance shall be made for the addition of additional PIR and daylight sensors in the future. Starting of lights shall be able to be "staged" on and "staged" off. Peak starting current should be minimised by ensuring lights start in a controlled manner.

The software system shall provide the following functions:

- It shall be possible to programme, configure, test and commission the system in stages without the need for a head end computer. The programme/intelligence should reside on a monitor-less PC or a server (it can also reside on an OPC server provided by the LCS supplier), which shall be sited within a cubicle (rack) in computer rooms available thought the building.
- The software shall provide for a full Internet connection so that the specialist supplier from their offices can monitor the system via the Internet and assist in trouble shooting.
- In addition the software shall have the ability to provide the data required for the head end to generate planned maintenance reports, alarms, energy reports etc.

- The information to be collated by the LCS shall include the numbers of hours run by each switchable as well as non switchable group of lighting (and individual luminaires utilising DALI ECGs).
- The head end would use this information for monitoring lamp life, energy consumption and for producing planned maintenance schedules and act as a management tool for monitoring status and historical performance of the building and load centres.
- The entire lighting operation shall be monitored in real time through graphical software on the control system.

1.1.1.2 System Functionality

The lighting control system shall be capable of working with an array of differing lamp sources i.e. able to control DALI as well as non-DALI controlled luminaires. Careful consideration must be given to ensure compatibility of system components. The distributed intelligence shall allow each DALI controller or DALI ECG to operate independently and without dependence upon the central controller or inline router. The lighting control network shall be capable of operating without a head end controller (PC)/ Area controller.

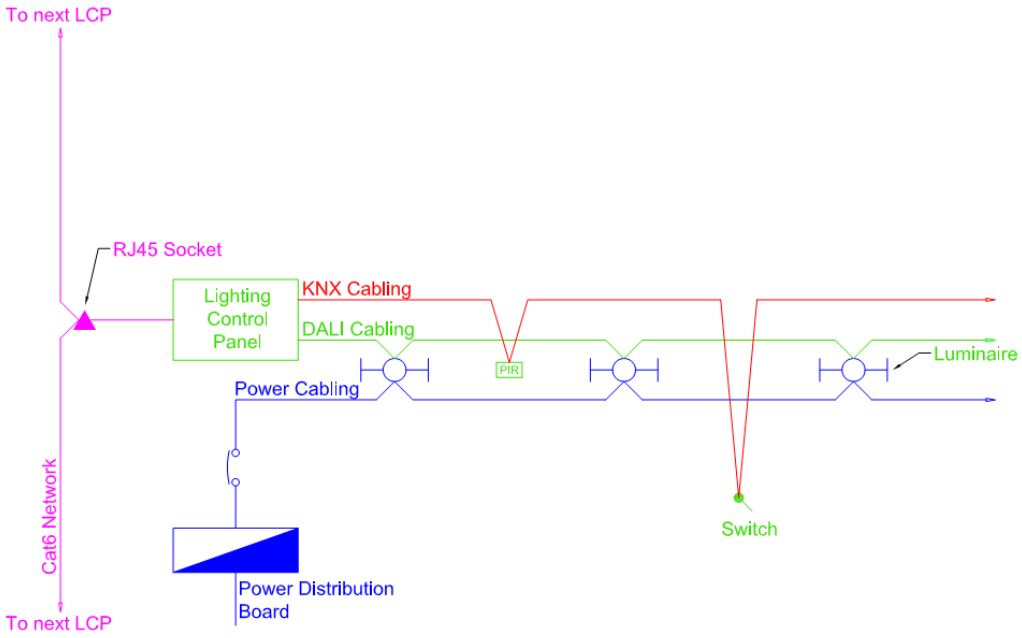
The lighting control system shall incorporate, but not be limited to the following:

- Floor controller/router in electrical risers and/or SCR's (as fire alarm/BMSC) subject to buildings and zones to be controlled.
- DALI controllers for controlling a minimum of 50 luminaires on any one DALI sub circuit.
- DALI regulated ECGs (subject to lamp type).
- DALI converters for lamp types where DALI ballasts are not available.
- Multi circuit lighting control modules.
- Ceiling mounted sensors.
- Photocells.
- ELV switches.
- ELV cable to luminaires.
- Interface to emergency central battery static inverter control modules.

Monitoring the whole of the lighting installation for status of luminaires – either individually or circuits as the case may be.

Monitoring and collecting data of the lighting installation for energy consumption, management and reporting to the head end.

The KNX lighting control system The lighting control system shall be capable of controlling the lighting to the complete building. An example fo the KNX/DALI network is shown below:



All fluorescent luminaries shall have high frequency control gear compact fluorescent and T5 lamps as detailed on the luminaire schedules.

Unless noted otherwise all luminaires ballasts shall be of the digital addressable lighting interface (DALI) type. The control protocol shall be set out to technical standard IEC 6029.

No mains switching is required to DALI luminaires. The ballasts shall receive a permanent un-switched supply via circuits emanating from local distribution boards as detailed on the tender plan drawings and distribution boards schedules.

1.1.1.3 System Requirements

The LCS shall be capable of providing full management control and monitoring of the combined lighting and emergency lighting system including:

- Calendar timing schedule.
- Addressing of individual luminaires as well as groups of luminaires.
- Time and date stamping including Time synchronisation signal.
- Naming of scenes, loads and controllers.
- Allocation of group switching arrangements.
- Active status of luminaires (on/off/dimmed etc).
- Lamp/ballast failure indication (DALI and emergency luminaires only).
- Software enabling local switching arrangements to be easily reconfigured.
- Automatic and manual control of system including any override facility (subject to password level acceptance within system).
- Password protection with various levels of access.
- Adjust set parameters for control devices.

- Production of planned maintenance reports (via the head end).
- Inputs to the lighting control system will come in various forms:-
- Local over-rides by means of button panels/key switches/presence detectors. These input units are to be supplied as part of the lighting control system.
- Automatically generated events triggered by the KNX system.
- Direct signals from other emergency/fire alarm systems, not necessarily routed via the head end.

1.1.1.4 Logical Grouping/Patching Requirements

In order to simplify programming and maintenance of lighting control, the system should allow for the patching of physical lighting circuits/luminaires into logical groups via the software. The scale of this installation is such that not all luminaires need to have a requirement for individual programming or addressing. Luminaires and circuits must be patchable into different logical areas / zones. Each zone must then be capable of independent scene setting.

1.1.1.5 System Specification

The Electrical Contractor shall employ a lighting control contractor to supply, commission and demonstrate an addressable KNX / DALI lighting control system as detailed within this specification. The Lighting Control Contractor shall be as follows: (or equal and approved)

Andromeda Telematics Limited

Tec 6. Byfleet Technical Centre, Canada Road, , Byfleet, Surrey, KT14 7JX

Contact : Steve Edgar 01932 341200

1.1.1.6 Environmental Conditions

The equipment shall be mounted within the various electrical services risers/cupboards and switch rooms shall be capable of operating under the following environmental conditions:-

Relative Humidity (RH) of up to 60%@ 20ºC

The equipment to be mounted within the terminal building and external to the building shall be rated for the following environmental conditions:-

Maximum Temperature (Tmax) of +40ºC

Minimum Temperature (Tmin) of -5 ºC

Relative Humidity (RH) of 80% at 25 ºC

1.1.1.7 Circuit switching modules

Where control of individual luminaires is not required such as Mechanical and Electrical Plant rooms, Archive & Storage Areas and back of house circulation, circuit switching modules shall be employed which shall provide secure control of multiple lighting circuits. These modules shall be located adjacent to the distribution boards serving the area, electrical cupboards or switch rooms.

The modules shall accept up to a minimum of 8 incoming circuits spread across 3 phases, controlled as individual addressed outputs from the KNX network. In the event of power loss to the module or electronics fault, the system shall default to an "ON" position. The enclosure shall be of robust steel construction. Where they are located in terminals or a damp environment, the modules shall be IP 54 rated.

1.1.1.8 Local Switching Devices

Subject to the areas the local switching methods to be employed include:

- XGS : X denotes the number of zone selection switches on the switchplate, e.g. 5GS : 5 button scene selector to select control zone in each space. Each to be provided with separate raise and lower and OFF buttons.
- D : Dimmer Switch - Raise & Lower & OFF buttons
- T : Local task lighting switch
- BM-S : Scene setting panel with Graphic interface for Special Exhibitions

Multi sensors comprising a combined passive, active and photocell are to be Theben "PlanoCentro" Range.

The multi-sensor shall combine infra-red receiver, movement detector and a photocell sensor into a single device enabling individuals to switch and dim lighting and override presence and daylight related commands using hand held personal infra-red transmitter.

Multi-sensors enable lighting to be switched or dimmed from a hand-held transmitter, while retaining the energy saving benefits of lighting switching off once areas have been vacated. The sensor functions should be individually configurable through the software to disable those not being used.

1.1.2 Control Strategy

Control Zoning

The Lighting Control Schedule outlines the lighting control strategy for each lighting control zone, as indicated on the Lighting Control Zones plans. For each zone, it is indicated whether the luminaires are to be dimmable, and if photocell control (daylight-linking), occupancy sensing or timeclock control is used.

Conservation Studios

Daylight-linking and occupancy sensing shall be utilised to control the lighting to maximise energy savings. All daylit spaces shall be split into zones as shown on the zone layouts in the Lighting Control Zone drawings. In conservation studios, zone setting switch(es) shall be provided in each space to allow occupants to override the photocells and dim up to 1,000lx. Under normal operation, lighting shall dim up and down according to daylight levels measured by photocells mounted in each space, such that a constant illuminance level is achieved. On entering a space the lighting shall switch "ON" to a general level of 500lx (including daylight where possible). Should an occupant override the standard control and dim up to 1,000lx the photocell shall be overridden. Should there be no movement in that zone for 10 minutes the lighting in that zone shall turn dim to the general level of 500lx, then turn "OFF" if no movement for another 5 minutes.

It shall be possible to set the target lux level for dimming for the daylight-linked controls via the central PC.

Office Space

All office lighting, toilet lighting and lighting to spaces with occasional occupancy shall use occupancy (passive infrared, or PIR) sensors. In these, lighting switches on via the PIR sensor when person enters space; the lighting switches off after 15 minutes if no occupant is detected (the length of this time delay shall be programmable via control system). 10 Wireless switches are to be provided for office space in Plot 5 **and 10 wireless switches are also to be provided for the office spaces on Level 6**. Wireless receivers shall be provided on each Lighting Control Panels (LCP) on levels 1, 0, B1 in plot 5 **and for each LCP on Level 6**

A lighting controller shall be located in or adjacent to each space, where shown on the plans. This shall be either in the form of a simple push-button controller allowing recall of pre-set scenes for the zone(s) (e.g. switches with suffix – "S") associated with the controller, or PIR sensor for the space, or both.

Special Exhibitions and Palestine & Cracherode Rooms

Special Exhibitions shall have a controller installed in a location inaccessible to the public, and the controller shall include a socket to allow a laptop computer to be plugged in to reprogram the lighting scenes in the space. In addition, it shall be possible to access the lighting control system in these spaces using a networked PC, laptop or tablet computer, via a wireless network that is to be installed as part of the lighting control system.

The scene setting for Special Exhibitions shall be programmed to fit in with the British Museums current schedule. **A software application shall be provided by the LCS manufacturer for installation on 2No dedicated handheld portable wireless handheld devices/tablets (e.g. iPad) to allow remote control and monitoring of the lighting and sub-zone lighting within the Special Exhibitions Gallery and Palestine & Cracherode Rooms.** An override Scene Setting panel (BM-S) shall be located outwith the gallery space to allow users to override the system when required. Each circuit on the 3-circuit lighting track halo shall be able to be individually addressed and therefore controlled separately from other circuits and "halos" allowing switching & dimming of each circuit separate to the other "halos" in the space. It shall be possible to adjust of "halo" groupings and dimming levels in the system software.

Wireless receivers shall be provided for all LCPs serving the Special Exhibitions Gallery and Palestine & Cracherode Rooms.

Display Case lighting shall be controlled from the central control system through floorbox power circuits.

PIRs shall be located above the mesh at the entrances to operate the security patrol lighting during the evening.

The Special Exhibitions lighting control panel (BM-S) shall have a graphical user interface and this user interface shall be capable of time clock and daylight control.

Loading Bay

Loading Bay lighting shall be controlled by PIR. On entering a space the lighting shall switch "ON" to a general level. Should there be no movement in that zone for 10 minutes the lighting in that zone shall turn dim to approximately 50%, then turn "OFF" if no movement is detected for another 5 minutes.

1.1.2.1 Emergency Lighting System requirements

In addition to maintaining and operating the lighting control system, an additional requirement for the system is to control, monitor and test the emergency lighting system.

For details of emergency lighting refer to V56 – Emergency Lighting – Central Battery Systems in ARUP-60-SP-0002

System Interfaces

1.1.2.2 System Interfaces

Fire Alarm System Interface

The building shall be divided into a number of zones when interfacing with the fire alarm system. Under an emergency condition when the fire alarm system is activated, the LCS shall bring ON to 100% output within the times set out in the relevant British Standard, all those emergency luminaires, that have been held in a switched off or dimmed position, within the fire zone of the particular building.

Upon failure of this function, the LCS should have an option of manually over-riding the current emergency lighting status to "fail safe" to 100% output.

1.1.2.3 Reporting

The lighting control system shall be able to provide data to allow the client to produce energy data over daily, monthly or yearly periods. This data shall then be utilised by the head end to generate energy prediction spreadsheets and graphical representations of energy consumption based on input data and then comparing this with the project energy targets (GJ/m²/pa).

The reports shall generate the following information:

- Run time data (the cumulative number of hours the luminaires have been in operation).
- Location and allocation of cost centres within a building.
- Weekly reports detailing kW hours per department.
- Maintenance Reports
- Throughout all areas of the building, the LCS could help the maintenance engineers to plan and schedule workload profiles by generating planned maintenance schedules.

The system shall provide the following information for the client to prepare a planned maintenance report:

- Active status of luminaires.
- Run time data (the cumulative numbers of hours the luminaires have been in operation.

- Recommend schedule to test emergency lighting on an area-by-area basis and to schedule emergency lighting on an area-by-area basis and to schedule emergency tests a regular intervals.
- Recommend schedule to test and monitor central battery systems including static inverters and DC battery systems.

1.1.2.4 Site Installation and Commissioning

Prior to the delivery of any item to site, the supplier shall prepare and obtain approval for his Installation and Commissioning Method Statement.

This shall detail each aspect of equipment installation covering:

- Requirements upon others
- Installation procedure
- Health & Safety considerations
- Disposal of waste
- Security and communication
- Testing and verification process

During the above phase the supplier shall provide weekly status update reports detailing on-site progress, holding issues, accidents and injuries, 4 week look-ahead and work undertaken in the previous week.

1.1.2.5 O & M Documentation

At least 8 weeks prior to commencement of Client / End User training, the Supplier shall provide 3 hard copies of draft project specific Operation and Maintenance Manuals for approval by the Building project team.

The O&M manuals shall be in the English language and contain all information that might be required by ‘technicians’ in understanding the general theory of operation, practical operation, corrective and preventative maintenance, repair & maintenance functions etc. In particular, for the first step of fault finding, a fault finding analysis flow chart shall be provided with further flow charts for more detailed analysis.

The O&M manuals shall primarily contain the following:

- Name, Address & Contact details of each Supplier / manufacturer.
- Index sheets
- Comprehensive glossary where specialised terminologies and acronyms are explained.
- Full Technical System Description.
- Schematic drawings, GA’s wiring and loop diagrams etc
- Spares part Schedule and AMA listing
- Routine Tests and periods.
- Maintenance log.

- Battery details, where used.
- COSHH statement.
- Operation procedures.
- LCD Display procedures.
- Trouble shooting details.
- Maintenance procedures.
- Tools and special equipment
- Assembly/ dismantling procedures.
- Calibration certificates
- Proprietary manuals and datasheets
- Software description and code breakdown
- Additional information where its presence further aids operation, maintenance and safety

1.1.2.6 Training

All necessary training of the Building Project Team and / or the End User to operate and maintain the system shall be provided, including fault finding and rectification. Training sessions shall be arranged to occur at least 8 weeks prior to project handover, for which a draft O&M manual will be made available together with current copies of the working project drawings. Supporting documentation for the training courses in the form of project specific training notes shall be provided.

The quantity and type of training sessions will be determined based upon operator and maintenance staff availability.

1.1.2.7 Handover

Project handover shall not be offered to the End User until the SAT has been completed, including the satisfactory addressing of all observations, approval of the O&M manuals, provision of training and the handing over and approval of as-built / installed documentation.

1.1.2.8 Asset Selection

The supplier shall, during the course of design and prior to FDS approval, issue a list of all items and item quantities that will be used to fulfil the project solution. A recommended list of spares and associated quantities shall be provided.

1.1.2.9 Warranty

Warranties on all hardware, software, configuration and system operation shall be provided for the following:

An extended warranty / caretaker maintenance from system operation to project handover

A warranty for a minimum period of 12 months after formal project handover.

1.1.2.10 Electronic Documentation

Documentation including project programmes, drawings, specifications, correspondence and all other information shall be provided in the latest electronic format. These currently comprise:

- Word
- Acrobat
- AutoCAD

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