TECHNICAL DIRECTORATE

Material and Workmanship Specification: Mechanical, Electrical and Public Health JV21 Lighting

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JV 21 LIGHTING

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JV21.1000 SCOPE, SUBMITTALS, TESTING AND PERFORMANCE

JV21.1100 SPECIFICATION AND SCOPE

JV21.1101 Specification Type

a) This is a Descriptive Specification where the *Contractor* shall complete the Detailed Design, manufacture, supply, install and warrant the works associated with this equipment as indicated on the Design Drawings and criteria stated in the Specification.

b) Where a particular material, product or supplier is indicated in the Specification, such material, product or supplier shall be deemed indicative representing the *Project Manager*'s design intent only. The *Contractor* may complete the installation using that product, or equivalent as acceptable by the *Project Manager* in writing, but shall remain fully responsible for the Detailed Design and performance of the works.

c) The Works documentation shall be applicable.

JV21.1200 SYSTEM DESCRIPTIONS

JV21.1201 General

a) This section is the specification for lighting and its control that is applied to the works.

JV21.1300 PERFORMANCE REQUIREMENTS

JV21.1301 Lighting Design

a) The *Contractor* shall verify the design intent and complete the design, change if required, and shall supply, install and terminate all luminaires in all areas.

b) The design, supply, installation, testing and commissioning, and putting to work, shall be in accordance with the standards listed within the "Crossrail New Works Baseline - Document Reference: CR/ QMS/ DEV/ P/ 0155".

c) The *Contractor* shall provide adequate and correct:

i) Illumination levels.
ii) Uniformity of distribution
iii) Limiting glare index

d) For back of house/ staff and other areas not detailed in the Specification, comply with the relevant LU Lighting Standard 1-066.

e) Provide calculations for each installation (Normal and Emergency) to demonstrate that the required criterion has been satisfied.

f) All Lighting schemes shall be agreed by the *Project Manager* prior to implementation.

g) The Detailed Design shall be based on the reference design or equivalent, as approved by the *Project Manager*, as detailed in the luminaire schedule.

h) The lighting installation to comply with the requirements of Building Regulations document L2, with particular reference to the efficiency and energy use of all LEDs and luminaires.

i) Luminaires shall have an IP rating appropriate for the environment.

j) Secondary safety support to be provided for diffusers, louvers and gear trays so that they are prevented from falling if their primary support should fail or is released.

k) Luminaires of similar types to have the same photometric performance.

l) Areas within the station of high criticality shall have permanently installed lighting to facilitate inspection, maintenance and faulting finding activities.

m) Luminaires shall be connected to the fixed wiring via robust and compliant industrial captive plug and sockets; the sockets shall be installed immediately above, or immediately adjacent to the luminaires.

n) The connection between the luminaire and the plug and socket shall be via SY armoured cable rated 600-1000V.

JV21.1302 Emergency Lighting

a) Emergency and exit lighting shall be supplied from the emergency lighting UPS system to provide continuous illumination of the station during either partial mains failure (failure of either the A or B supply) or total mains failure. The UPS battery autonomy will be 3hours for emergency lighting.

JV21.1303 Lighting Control

a) A DALI or Equivalent lighting control system shall be provided to all luminaires and lighting systems with a manual over-ride control in the Station Operations Room (SOR).

b) The DALI lighting control system shall allow operation of the public area lighting according to the following scenarios:

i) Open to public
ii) Closed to public
iii) Closed to public - maintenance operation
iv) Fire alarm operated
v) Power failure
vi) Emergency lighting test
vii) Daylight sensing
viii) Dusk to dawn control of external lighting
ix) Control of illuminated signage

c) In the SOR a lighting control panel for central control and dimming to all areas shall be provided. In back of house areas, the DALI lighting control system shall be used to monitor the status of the lighting and switch the luminaires via local demand switches, PIR and presence detector sensors. Generally, light fittings of a similar type shall be grouped together for the purposes of switching as a sub-zone. The *Contractor* shall develop a final lighting control system which shall be approved by the *Project Manager*.

d) The *Contractor* shall provide and commission a zoned lighting control system which accommodates the requirements of the Tender package, and shall be in accordance with the BREEAM Credit 'HEA 6', specifically items 'a' 'b' and 'c'. With particular reference to this the lighting over desks within the SOR shall have separate variable (i.e. dimming) control for the occupant.

e) The *Contractor* shall provide and commission a zoned lighting control system which includes proportional dimming of luminaires adjacent to windows and the external environment. Carry out a quantitative daylight analysis which identifies appropriate luminaires to be dimmed as a result of daylight ingress and the most appropriate level of dimming to be employed for different luminaires.

f) The *Contractor* shall provide drivers to all LED modules, in accordance with BREEAM Credit 'HEA 4'.

g) The *Contractor* shall provide local daylight-linked control, through the DALI system, for all luminaires which are external in accordance with BREEAM Credit 'ENE 4'. All external luminaires shall also meet the energy efficiency criteria specified in the same credit. This also includes external feature lighting in the ticket hall areas.

h) The lighting control system shall provide the system components for remote monitoring and reading of DALI panel data, either

remotely or locally, shall not prevent or inhibit the panels from their primary lighting functionality.

i) All functionality that is available remotely shall be available via local access at each DALI lighting control panel.

j) The DALI lighting control panels shall interface with the BMS via a TCP/ IP/ Ethernet connection. A Cat 6 cable shall be run between the DALI panels and the nearest BMS LAN switch via an RJ45 patch panel.

k) Where lighting control panels are more than 90m away from a BMS outstation, fibre optic media converters shall be used to link the networking switches to the lighting panels. Refer to JW60 for further requirements regarding this type of transmission.

l) The DALI lighting system control shall be undertaken on a DALI lighting server / master controller, or via software on the BMS server. Commands shall be sent from the workstations to the server / master controller for processing.

m) Any commands sent by the SMS or external BMS workstations shall be directed to the server or master controller for processing to manage conflicting commands, or setting changes, originating from multiple sources.

n) The timings used for DALI scene triggering and automatic emergency lighting tests shall be based on the BMS network time, which shall be synchronised with the route wide master clock via the Station LAN and station clock distribution unit.

o) The DALI panels shall have seven methods of control (in order of priority):

   i) Priority 1 (highest) - Fire panel "Luminaires to full brightness" override.
   ii) Priority 2 - Emergency lighting / UPS test mode.
   iii) Priority 3 - Station Operations Room (SOR) lighting override panel.
   iv) Priority 4 - Local switches and sensors.
   v) Priority 5 - BMS operation from on-site BMS workstations.
   vi) Priority 6 - BMS operation from the SMS.
   vii) Priority 7 (lowest) - BMS operation from off-site BMS workstations.

p) Commands / requests from higher priority interfaces to the DALI lighting system shall always take precedence over commands / requests from lower priority interfaces. The DALI lighting server / controller shall manage the priority and execution of commands.

q) DALI panels shall be supplied with USB interfaces to allow maintainers to configure the panels and drivers locally via laptops. Commercial Off The Shelf (COTS) software and drivers shall be supplied to enable this functionality.

r) The BMS shall provide a flexible network, such that the additional panels can be added to the system without compromising the overall performance of the DALI lighting system.

s) The lighting control software shall be integrated with the BMS workstation supervisor software. Otherwise COTS software shall be utilised instead.

t) The BMS lighting control software shall provide the following functionality from the BMS workstations:

   i) The ability to program and trigger scenes
   ii) The ability to change between automatic (timer) mode and manual modes.
   iii) The ability to set and edit the scene trigger times.
   iv) The ability to program / configure the EEPROMs within individual lighting drivers
   v) Record trend data of the DALI panels, drivers and lighting fixtures for maintenance purposes.

u) The driver tables within the DALI control panels shall be configurable from the BMS workstations via the BMS LAN. The BMS workstations shall be capable of interrogating and configuring every DALI panel within the station.

v) The lighting control software shall record the following information on the BMS Servers:

   i) LED wattages
   ii) The date a LED module was first started up
   iii) Dates of driver and LED module replacement
   iv) Dates of cleaning.
   v) Number of LED modules per fitting / driver
   vi) Total number of hours that each LED module has run.
   vii) The maintenance period of Plant, LEDs and drivers

w) The lighting fixture / driver database(s) shall be of a common format, accessible via SQL and / or other open industry standard interface. The lighting control software shall be compatible with the database and its interface.

x) The software suites used as part of the lighting control system shall be subject to the same security restrictions and measures as the rest of the BMS software suite to maintain the integrity of the BMS.

Penetration tests shall be undertaken during commissioning to test the security of the lighting sub-system.

y) Password protection shall be used to prevent unauthorised alterations to the DALI lighting control.

JV21.1304 Failure Modes

a) Any telecommunications failure between the fire system and any of the DALI panels shall cause the lighting drivers to enter in to a “hold at last setting” mode instantaneously.

b) The BMS shall raise an alarm on the BMS workstation if communication is lost between the fire panel and any of the DALI panels within five seconds of the failure.

c) Any telecommunications failures between the BMS and any of the DALI lighting system interfaces shall raise an alarm on the BMS workstation within five seconds of the failure.

d) The DALI lighting system shall continue unaffected if the BMS or the BMS LAN fails(except the ability to remotely control and monitor). Local control of lighting control panels shall still be possible.

JV21.1400 MATERIALS

JV21.1401 General

a) Materials shall have been found acceptable by the Materials Compliance Process and included in the Materials Compliance Record (MCR).

JV21.1402 Luminaires

a) Luminaires to comply with BS 4533, BS EN 60598: Part 2.22 and BS EN 13032-1.

b) Signs and high voltage installations to comply with BS 159.

c) Luminaires to meet the requirements of the Electromagnetic Compatibility Regulations in their design and manufacture, allowing compliance in their operation and maintenance with the Electricity at Work Regulations.

d) Luminaires that are mounted in direct contact with the building fabric to achieve an 'F' rating in accordance with BS EN 60598: Part 2.22.

e) Wiring in luminaires to be of stranded copper, insulated with an LSOH material suitable for operation at 105°C. Where the wiring passes control gear operating at a higher temperature, fit the wiring with oversleeves of a suitable temperature capability.

JV21.1403 Diffusers and Louvers

a) Diffusers to be either opal or prismatic, and shall be in accordance with LUL 1-085.

b) Diffusers to be retained in place on the luminaire body by one of the following methods. (The method of attachment to provide support during the installation/ removal sequence):

i) Spring clips holding the diffuser tight to the body, retaining their effectiveness for the design life of the diffuser.
ii) Metal hinges

c) The incorporation of a metal bezel which is attached to the luminaire body with screws or patent securing devices.

d) Louvre finishes to be robust and able to withstand cleaning in the recommended manner.

e) Louvers to be attached to the luminaire body by seating on cut-outs or ledges formed in or on the body, securely retaining the louvre in place. No dislodgement due to vibration of the mounting surface or accidental impact is acceptable.

f) Provide louvers with safety chains or wires.

JV21.1404 Light Emitting Diodes (LED's)

a) LED's of each type to be supplied by the same manufacturer.

b) At completion of the contract the *Contractor* shall provide 20 spare modules of each module type.

JV21.1405 Control Gear

a) Luminaire control gear and associated components to be suitable for the LED type, wattage and starting characteristics. Confirmation of compatibility to be obtained from the manufacturer.

b) Provide a fixed screw terminal block to receive the incoming supply cables, including the protective conductor, with each terminal suitable for receiving three 2.5mm² conductors.

c) Luminaires equipped with LEDs rated in excess for 20 watts to be fitted with a fixed fuse holder and fuse in accordance with BS 1362. Fuse holders may be combined with the terminal block.

d) Where the control gear is not mounted within the luminaire, mount in a separate sheet steel enclosure with the same index of protection and finish as specified for the luminaire. Fit the enclosure with a lid or door requiring a tool or key to open it. The cable length between the control gear and the LED not to exceed the maximum recommended by the manufacturer.

END OF 1000 SERIES

JV21.2000 SUBMITTALS AND TESTING

JV21.2100 SUBMITTALS

JV21.2101 Pre-contract Samples

a) Not required

JV21.2102 Post Contract Samples

a) Not required

JV21.2103 Mock-up Requirements

a) Not required

JV21.2104 Prototype Requirements

a) Not required

JV21.2105 Design considerations in line with Crossrail “RAM”

a) The “Expected” and Warrantied LED Life will be a minimum of 60,000 hours.

b) The “Expected” and Warrantied LED DRIVER Life will match that of the LED.

c) The design will allow for and include specific safety / maintenance features to ensure luminaire longevity / functionality including LED thermal monitoring with In-built “Back-up” components.

d) The construction and material specification will be suitable for the expected life of the “PES”.

e) The “life” component count, will including and account for all perishable items I.E. gaskets etc.

f) All “mission critical” components will be “easily” exchanged without removing the fitting from its location, including fascia panels in the event of breakage.

g) Maintenance must be able to be carried out safely without disrupting / isolating the LV supply.

JV21.2200 TESTING

JV21.2201 General

a) Testing shall be carried out to the manufacturers instructions and recommendations.

Off-Site Testing

a) Off site testing is not required for proprietary and standard equipment.

b) Standard manufacturers test certificates shall be provided.

On-Site Testing

a) On-site testing of each system is required.

b) Commissioning of each system is required.

END OF 2000 SERIES

JV21.3000 FABRICATION AND WORKMANSHIP

JV21.3100 FABRICATION

JV21.3101 Fabrication tolerances as dictated by local installation constraints. This will require coordination with other installation teams including for example the suspended ceiling fixers.

JV21.3200 WORKMANSHIP

JV21.3201 Installation

a) Comply with the requirements of Building Regulations Document L2 with particular reference to the efficiency and energy usage of all LEDs and luminaires.

b) Luminaires shall have an IP rating appropriate for the environment.

c) Secondary safety support to be provided for diffusers, louvers and gear trays so they are prevented from falling if their primary support fails or is released.

d) Luminaires of similar types to have the same photometric performance.

JV21.3202 Luminaire Installation

a) Adequately support all luminaires. Those over 600mm in length to have two supports and those over 300mm in width to have four supports.

b) Where luminaires are mounted direct from conduit, each mounting point to comprise a conduit box.

c) Conduit used to suspend luminaires to be made from class iv galvanised steel and have a minimum diameter of 20mm. Where the conduit enters the luminaire, use back-nuts and washers to secure the luminaire body to the conduit.

d) Luminaires supported from trunking to be mounted using proprietary clamps or brackets.

e) Chains used for suspending luminaires to be corrosion resistant steel links. Carrying capacity of each chain to be at least twice the total weight of the luminaire.

f) Safety wire system used for suspending luminaires shall be manufactured from galvanised steel to EN12385.

g) Recessed luminaires to be installed flush with the finished ceiling level, and unless otherwise agreed be supported from the soffit above, their weight not borne by the ceiling by means of one of the above mentioned methods (conduit, chain or safety wire).

h) Final electrical connection to all luminaires to be via five 6491B LSOH insulated single core cables installed within flexible conduit. Cables to be connected directly to luminaire terminals at load end and via robust & compliant captive plug and socket at the supply end. The plugs and sockets to comply with BS 6972 and BS 7001.

i) The flexible conduit shall comprise Stainless steel (316) over braided coated helically wound galvanised steel conduit with extra low fire hazard polyolefin jacket that:

   i) Provides excellent extra low fire hazard and halogen free properties
   ii) UL94 VO flame retardancy
   iii) Highly flexible
   iv) High abrasion resistance
   v) High mechanical strength
   vi) Provides EMC screening
   vii) UV resistant (where used outdoor)
   viii) Very high tensile strength
   ix) Vandal/tamper resistant

j) Loose wiring within a luminaire to be clipped or tied back using suitable proprietary fixings at no more than 300mm intervals.

END OF 3000 SERIES

JV21.4000 SYSTEMS INTEGRATION AND HANDOVER

JV21.4100 SYSTEMS INTEGRATION

JV21.4101 General

a) The *Contractor* shall ensure full integration of the equipment into all the interfacing systems.

JV21.4200 HANDOVER

JV21.4201 General

a) The *Contractor* shall provide all documentation as required by the *Project Manager* at completion of the works.

END OF 4000 SERIES

END OF SECTION JV21