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Consulting Engineers

Sport Wales National Centre – Sophia Gardens

Main Arena Lighting upgrade works

Stage 4 Specification for Electrical Engineering Services

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Sport Wales National Centre – Sophia Gardens
Switchgear Replacement and Upgrade Works

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ELECTRICAL SPECIFICATION SCHEDULES

1.0 CONTRACT CONDITIONS AND PRELIMINARIES

1.01 General

The Contractor shall take note of and be deemed to have read the entire specification, including all clauses, sections, and schedules, whether or not they relate directly to the Works. Where any clause refers to items, equipment, or information not forming part of the Works including but not limited to fan belts, gaskets motors, or similar ancillary items, such reference is included for context, cross-reference, or information purposes only and shall not be construed as expanding, limiting, or otherwise altering the scope of the Works.

For details of Contract Conditions and Preliminaries, refer to Main Contract Documents issued by the Employer/Employer's Agent.

This specification, together with any accompanied drawings, provides indicative design requirements and criteria for the Electrical Engineering Services Installations for the construction of ***Replacement of the existing main arena lighting installation***. The Contractor shall note that should there be any discrepancies between the documents then the most onerous requirements shall apply.

The building is to an existing unit.

The documents indicate minimum Employers Requirements to enable the Contractor to provide a tender for the works.

The total supply, installation, setting to work and commissioning of the Engineering Services shall be the responsibility of the Contractor.

1.02 Program of Works

The contractor shall ensure that all works are undertaken and fully complete and commissioned within the following timeframe.

No additional costs shall be accepted for the provision of additional labour and plant to ensure completion within this timeframe.

Completion of this tender is deemed to confirm that the contractor shall complete the works in the timescales.

<u>Contract Award Date:</u>	<u>05-10-2026</u>
<u>Compound Set-Up</u>	<u>30-11-2026</u>
<u>Works Commencement Date:</u>	<u>07-12-2026 (including weekend)</u>
<u>Completion Date</u>	<u>14-12-2026 – 17:00</u>

The site will be available to the contractor during the following hours 08:00 – 20:00 7 days per week

The works must be complete by this time to ensure continuity of service for the client

1.03 Scope Of Works

The Contractor shall be fully responsible for the supply and installation throughout and shall ensure full compliance with all current recognised standards and recommendations.

The scheme installations and commissioning shall comply with all relevant standards, regulations and legislation (except where expressly modified and/or extended as indicated elsewhere), including the following:-

- Latest edition of the Regulations for Electrical Installations, IET Wiring Regulations and any amendments (BS 7671).
- CIBSE Guides and any amendments published by the Chartered Institute of Building Service Engineers.
- British Standards and British Standards Code of Practice and any amendments issued by the British Standards Institution.
- BSRIA Applications and Commissioning Guides.
- The Health and Safety at Work Act including the Management of Health and Safety at Work Regulations, The Construction (Health, Safety and Welfare) Regulations. The Construction (Design and Management) Regulations for both Design and Construction Duties.
- BS 8300 Approved Document M and The Disability Discrimination Act.
- Electricity at Work Regulations.
- The Electrical Supply Regulations.
- The County Fire Officer's Recommendations.
- Building Regulations and other Statutory Requirements.
- The requirements of the Electricity Supply Companies.
- For Teaching Facilities - the Education (School Premises) Regulations 1999 and Building Bulletin 87 Guidelines for Environmental Design in Schools.
- Any other appropriate Design Guides and Guidance Notes.
- Consortium of Local Authorities in Wales (CLAW).

The Contractor shall install, set to work and commission the following systems (where applicable):-

- New Containment System.
- Lighting.
- Emergency Lighting.
- Lightign Control System.
- Earthing.
- Temporary Supplies.

The Contractor shall ensure that all necessary materials are obtained in time to bring the works to a satisfactory conclusion in accordance with the contract programme for the works.

1.04 Submission of Documents and Approvals During Installation Period

Upon appointment, the Contractor shall forthwith proceed to prepare for comment preliminary installation drawings, certifications and builders information drawings which shall be developed from the Contractor's Revit Model. Approval must be obtained from the Contract Administrator before any work commences on any particular part of the installation.

Approval by the Employers Representative will mean the acceptance in principle and, in the event of any omission or error by the Contractor in the information provided, the works shall nevertheless be executed as if they had been correctly shown, without additional payment.

All documentation shall be submitted progressively for review and in sufficient time to meet the contract programme and to avoid delays to the contract allowing for a minimum review period of two weeks.

Installation drawings shall consist of the following, but not be limited to these requirements.

- General Electrical Services Layout Drawings (1:50, 1:100 scale).
- Distribution Drawings (NTS).
- Manufacturers General Arrangement Drawings of all equipment, plant, special fittings, etc. as required by the Engineer.
- Wiring Control Diagrams and Schematics forming part of the works (NTS).

When all installation, co-ordination drawings and any other relevant documents have been finally completed, the Contractor shall provide to the Employers Representative up to six copies of all these items for general use.

1.05 Building Regulation Compliance

The Contractor shall ensure that the installation is in compliance with the Building Regulations.

The selection of equipment shall be integrated with the building fabric, mechanical services and sustainable technologies to ensure satisfactory SBEM calculation result.

2.0 STANDARD SPECIFICATION

2.01 General Details

2.01.01 Compliance with Specification

This section of the Specification describes standard requirements for workmanship, materials and management procedures to be used in the execution of the works described in this Specification and on the drawings.

The works shall comply with all relevant requirements of standard sections of this Specification except where contrary requirements are indicated in the particular Specification and the drawings shall take precedence.

Costs incurred by the Employer's Representative as a result of any part of the works failing to comply with specified requirements shall be deducted from payments due for the cost of the works. Such deductions shall include but not be limited to costs incurred for:

- * Preparation of snagging lists, defects lists or other supervisory documents made necessary by the existence of an unreasonable number of items still requiring attention after any section of the works has been offered to the Employer's Representative, as being complete and ready for inspection;
- * Additional inspections, witnessing, approvals or other attendances;
- * Any associated redesign work;
- * Preparation and printing of drawings and details;
- * Supervision and administrations.

2.01.02 Definitions

The following definitions and associated requirements shall apply to terms used in this Specification.

Approval of a drawing or any other element of the works shall be deemed to indicate that the Employer's Representative has no immediate objections or comments. Such "approval" shall not be construed as acceptance of any responsibility for the accuracy or quality of the works or for any fault, error, omission, defect or deficiency that may subsequently be noted. All approvals shall be subject to written confirmation signed or countersigned as appropriate by the Employer's Representative.

The Drawings are the drawings issued in conjunction with this Specification for tendering purposes or subsequently issued under the Contract.

Working Drawings shall be any necessary drawings, sketches, diagrams, schematics, programmes or other illustrations provided in the execution of the works:

- * To determine the locations, dimensions, wiring requirements, builders work and other details of elements of the works, as necessary for the execution of the works and/or;
- * For approval of such details by the Employer's Representative or any other relevant authority.

The Employer's Representative shall be the Architect, the Engineer, the Project Manager or other party designated under the Conditions of Contract to inspect, approve, witness or accept the works on behalf of the Employer and to issue instructions under the Conditions of Contract.

Issued for Construction or similar phrases used in the course of issuing drawings or information by the Employer's Representative shall be deemed to mean that such drawings or information shall be used as the basis for the production of working drawings.

Materials shall be any materials, plant, equipment, drawings, expendable items, packaging, rubbish or any other elements used in or arising from the implementation of the works, as appropriate to the context.

The Specification shall be this Specification together with the drawings and any other relevant requirements of the Contract or instructions issued under the Conditions of Contract.

Witnessing of a test, commissioning or any other activity shall be construed as confirmation of the results of such activity; it shall not be construed as either approval or acceptance. The same qualifications shall apply as for "Approval".

The Works shall include all materials, labour, plant, testing, commissioning and other commodities or activities necessary for the completion of the work described in or implied by the Specification and governed by the Conditions of Contract.

2.01.03 Extent of the Works

The works shall be deemed to include every item described in the Specification and every item shown on the drawings together with all activities, materials, labour, plant, adjustments, attendance, fixings, supports, brackets, the preparation of working drawings and other items necessary for the provision and commissioning of complete installations in accordance with the intent of the Specification and the drawings and in accordance with good practice.

The works shall include all necessary provision to take account of details not shown on the drawings owing to their diagrammatic nature. This requirement shall include all materials and activities necessary for the co-ordination of the works with details on architectural, structural and other drawings available at the time of tendering or subsequently issued under the Conditions of Contract.

Such terms as 'provided', 'supplied', 'fitted', 'fixed', 'installed', etc, when used in this Specification or on the drawings shall be deemed to include the supply, fixing, placing in position, adjusting, testing, regulation, commissioning and putting into working order of the relevant equipment including any necessary ancillary equipment or activity, except where the intended meaning is specifically limited by such phrases as 'supply only' or 'supply and had to the Employer's Representative'.

2.01.04 Co-ordination and Access

The works shall be installed in co-ordination with other services installations and the building fabric. Details of such co-ordination shall be agreed before fixing of any item in each particular area of work.

Every component shall be installed in such a manner as to be readily and safely accessible for any normal observation, adjustment, maintenance or other activity required of its use. The works shall be deemed to include all reasonable provision for compliance with this requirement, including co-ordination with other services and structural features.

The decision of the Employer's Representative shall be final in respect of what is readily and safely accessible.

Any apparent instance of a component being shown on the drawings in an inaccessible position shall be drawn to the attention of the Employer's Representative before the item and associated components are installed.

All components shall be delivered to site in a form suitable for the access available for positioning, assembly, installation and eventual renewal and replacement.

Co-ordination of the works shall be deemed to include any necessary moving or circumventing of any plant or other obstructions placed on site during the course of building or other trades work.

2.01.05 Mandatory Requirements

The term "shall" indicates that a statement is a mandatory requirement of this Specification.

The decision of the Employer's Representative shall be final in respect of whether any other statement in the Specification can reasonably be interpreted as being a mandatory requirement.

2.01.06 Confidential Documents

This Specification, the drawings and all other associated documents shall be regarded as confidential.

All confidential documents shall be returned to the Employer's Representative after being used for tendering purposes.

2.01.07 Letters of Intent

In certain circumstances, the Employer may find it necessary to issue a letter of intent to a supplier before the Contract is placed, in order to reserve materials for delivery on a date to suit the anticipated programme of work. Immediately after the Contract is placed, an order shall be issued for the supply of any reserved materials.

The order placed for reserved materials shall confirm all requirements as detailed in the Specification and the drawings. All requirements of the Specification and the drawings shall take precedence over any different or less detailed requirements contained in the letter of intent.

2.01.08 Beneficial use of the Works prior to Practical Completion

In certain circumstances, e.g. involving modifications to existing installations, the Employer's Representative shall have the option to instruct that any part of the works be operated for the beneficial use of the Employer before the issue of a Certificate of Practical Completion.

Except where specific provision for such beneficial use is included in the particular Specification, the Employer shall reimburse reasonable costs associated with the operation of the system and any measures necessary to enable the full defects liability period to be effective from the date of Practical Completion. Such reimbursements shall be evaluated in accordance with the Conditions of Contract.

2.01.09 Familiarity with Site

The works shall be deemed to include all necessary provision for factors particular to the site that could be ascertained by visiting the site prior to the submission of the tender for the works. Such factors shall include but not be limited to:

- * Access;
- * Existing buildings;
- * Existing services;
- * Any other factors that could affect the progress of the works or the cost of the works.

2.02 Regulations and Standards

2.02.01 Conformity with Regulations

The current requirements and recommendations of all relevant codes of practice, statutory regulations, bylaws, commissioning codes and installation instructions shall be complied with during the execution of the works, including the following:

- * The Health and Safety at Work Act;
- * The Construction (Design & Management) Regulations 2015;
- * The Workplace (Health, Safety & Welfare) Regulations 1992;
- * The Factories Act;
- * The Clean Air Act;
- * The Mines and Quarries Act;
- * The Public Health Act;
- * The Offices, Shops and Railway Premises Act;
- * The Building Regulations;
- * British Standards Institution Publications or, in the absence of a relevant British Standard, the appropriate ISO or CEN/CENELEC standard;
- * Requirements and recommendations of the local Fire Officer;
- * Requirements of local supply authorities for gas, water, electricity and mains drainage;

- * Gas Safety (Installation & Use) Regulations 1984;
- * Requirements of any insurance companies concerned;
- * IET Regulations for Electrical Installations;
- * The Electricity at Work Regulations;
- * CIBSE Commissioning Codes, Guides, Technical Memoranda and Practice Notes.
- * British Telecom LN139 (all buried ducts for services other than piped or LV/HV cabling).

Authorities shall be notified as necessary about the connection of electricity, gas, water and drainage.

The Contractor shall be responsible for liaison with the public utilities to facilitate the programming and co-ordination of the various utilities to meet his installation programme.

The Contractor shall also be responsible for submission of working drawings to the public utilities for approval.

2.02.02 Safety and Fire Precautions

Fully comply with the requirements of the latest version of the construction (design and management) regulations and adhere to the requirements of the Health and Safety Plan.

Safe methods of working and access shall be employed throughout the execution of the works.

All necessary precautions shall be observed in respect of special areas of work where hazards may exist in connection with dangerous substances.

Due cognizance shall be given to the risks of explosion, toxic gases and infection in existing drains. Particular care shall be taken in prisons and hospitals.

The works shall include all necessary provision for protective clothing, masks, goggles, breathing apparatus, safety lines and other equipment.

All necessary precautions shall be adopted to safeguard against fire and explosion and especially where the execution of the works involves lames, sparks, other sources of ignition or the use of flammable or explosive materials.

All necessary provision shall be made for maintaining the integrity of fire compartment walls, floors and other structural elements in the course of an after completion of the works.

2.03 Documentation

2.03.01 Drawings

The Drawings

The tender drawings are intended to depict the scope and intent of the works to such an extent as to allow tenders to be submitted and subsequently for use as a basis for the preparation of working drawings. The drawings shall be deemed to be not suitable for use as working drawings.

Any apparent conflict between requirements indicated on the drawings and requirements of the Specification shall be brought to the attention of the Employer's Representative. The Employer's Representative's decision shall be final as to which requirement should take precedence.

Working Drawings

Working drawings shall be submitted to the Employer's Representative within reasonable time to allow comment to be made to meet the required date in the agreed programme of work. In the event of additional details, drawings or other information being required to enable the working drawings to be completed, these shall be requested from the Employer's Representative at a time which is neither unreasonably distant from nor unreasonably close to the date required.

The working drawings shall include details of all builders work together with any additional information required for the preparation of final architectural details, e.g. of services shafts, floor ducts, brickwork surrounds for louvres, building-in of fire dampers, sleeves or cable transits, etc.

Triplicate copies shall be provided to the Employer's Representative of all working drawings. This requirement applies to issues for approval and, where appropriate, final issues.

Drawings to Scale

All drawings to scale shall conform with standard metric scales, i.e., 1:1, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, etc. The Employer's Representative shall refuse to approve any drawings using a non standard scale, e.g. 1:25, 1:33, etc.

Manufacturers' Drawings

The working drawings shall include certified manufacturers' drawings. These shall include details of all plant, machinery, control panels, switch panels. Purpose built equipment and other such items as may be requested by the Employer's Representative.

Manufacturers' drawings shall include the following, as appropriate:

- * Dimensions and weights;
- * Holding down bolt locations and other builders work details;
- * Wiring details, including terminal numbers;
- * Cabling requirements;
- * Starting and running currents and fuse ratings;
- * Required capacity of water, gas, steam or any other associated piped services;

- * Positions of connections of pipework, cables, flues and other components;
- * Integral maintenance access;
- * External access required for maintenance;
- * Any particular requirements for the operating environment.

As Fitted Drawings

As fitted drawings shall be provided as described under Record Documents.

Plant Room and Control Room Drawings

The works shall include the provision of plant room and/or control room drawings (hereinafter referred to as plant room drawings).

Plant room drawings for wall mounting shall be printed black on white plastic sheet or other approved material and framed and fixed on walls of the appropriate rooms. Frames shall be of hardwood and glazed. Where drawings are required to be mounted on control/indicating panels and/or consoles, they shall be engraved on traffolyte or similar approved plastic laminate.

Plant room drawings shall include the following appropriate and agreed with the Employer's Representative:

- * Detailed plant layout;
- * Plant operation charts and relevant instructions;
- * Plant room valve chart;
- * Controls Schematics;
- * System schematics;
- * Appropriate zone locations;
- * Any other details as may reasonably be required by the Employer's Representative for the safe and efficient operation of the relevant system(s).

2.03.02 Record Documents

Record documents shall comprise:

- * Drawings and schedules giving details of all installations “as installed”;
- * All test certificates;
- * All commissioning records/certificates;
- * All guarantees and warranties;
- * All insurance inspection reports and certificates;
- * Project completion records.

Record documents shall be available in draft form one month prior to Practical Completion or earlier to suit the requirements of user tuition during the commissioning period or sectional completion dates within the contract.

Record documents shall be approved by the Employer’s Representative before being finally issued to the Employer.

Record documents shall conform with all relevant requirements specified for working drawings.

The final issue of approved record documents shall be delivered to the Employer on site or other such location as may be required by the Employer’s Representative. A receipt including a detailed list of all record documents delivered shall be obtained and copied to the recipient and the Employer’s Representative.

Three complete sets of record documents shall be provided.

Each set of record documents shall comprise:-

- * A flash drive containing all drawings A3 and larger in **AutoCAD** drawing format files provided on an IBM PC compatible computer;
- * A set of paper prints of each drawing larger than A3 size, each contained in transparent PVC wallets;
- * A set of ring binders of appropriate size containing all ‘As Installed’ drawings and other record documents including a detailed drawing index;
- * A flash drive containing all record documents (other than drawings) in PDF format.

Record drawings shall provide at least as much detail as the drawings in respect of the locations of all plant, equipment, valves, isolators, switches, dampers, control panels, distribution boards, access panels, etc and the routes of pipes, trays, conduits, ducts, etc and any other components of the works.

Record drawings shall include schematic and diagrammatic details giving at least as much detail as the drawings together with all additional details included in the working drawings in respect of wiring diagrams, control panels, control systems, distribution boards, other specialist systems/ equipment and instrumentation. They shall include any other details necessary for the operation, maintenance,

dismantling, reassembly and possible future modification of all components of the installations included in the works.

Record drawings shall include all details necessary for the identification, location, size, rating, capacity or other detail necessary for the maintenance, operation, replacement or any other relevant activity of all plant, equipment, apparatus or other materials.

Record drawings may include appropriate details in schedule form.

Record drawings shall include all relevant details of builders work essential to the works. This shall include services shafts, cable containers, air ducts or waterways, structural supports and any other relevant items.

Record drawings shall include comprehensive details of all power wiring, control wiring, pneumatic or other controls system piping. Such details shall include sizes and types of conductors and piping and identify the terminal points of each.

The scales used on record drawings shall conform with those used on the drawings except where a more detailed scale is required by the following list:-

<u>Detail</u>	<u>Scale</u>
External Services	1:200
General Layouts	1:100
Plant/Equipment Room Layouts	1:50
Manufacturer's Details of Equipment requiring servicing	1:20

The size and scale of all record drawings shall be adequate to meet the approval of the Employer's Representative.

In the event of any record documents being unavailable at the time necessary for acceptance of the works as being practically complete, the Employer's Representative shall be empowered to employ any measures necessary for their production and to deduct the cost of such measures from payments applicable for completion of the works.

2.03.03 Operating and Maintenance Manuals

Comprehensive manuals shall be provided to assist the user in the safe and efficient operation and maintenance of all systems and equipment incorporated in the works.

The manuals shall include:

- * A general description of the scope and manner of working of each system and each item of plant and equipment;
- * A detailed description of the scope and manner of working for each automatic control/monitoring system, including wiring diagrams and schematics showing the interconnection between all plant and equipment;
- * Clear and comprehensive instructions for the method of starting up, running and shutting down of all systems, plant and equipment;
- * Details of all normal operating conditions and control set points;

- * Instructions in respect of any necessary precautions against damage to the installed works, e.g. from rust, corrosion, etc;
- * Instructions and schedules listing all items requiring periodic servicing and/or inspection, together with details of the necessary activities and recommended frequency thereof;
- * A detailed list of recommended spare and replacement parts, lubricants and any other expandable items, including catalogue references, part numbers, etc, as necessary for the identification of each item.
- * An electronic copy of the manual stored on a flash drive containing all sections of the completed manual including manufacturer's literature in PDF format.

Manufacturers' leaflets, booklets or other documentation that does not conform with A4 size shall be indexed and cross referenced in the manuals. Such documentation shall be presented in suitable box files or folders.

Operating and Maintenance Manuals shall be available in draft form one month prior to Practical Completion or earlier to suit the requirements of user tuition during the commissioning period or sectional completion dates within the contract.

Operating and Maintenance Manuals shall be approved by the Employer's Representative before being finally issued to the Employer.

The final issue of approved Operating and Maintenance Manuals shall be delivered to the Employer on site or other such location as may be required by the Employer's Representative. A receipt including a detailed list of all documents delivered shall be obtained and copied to the recipient and the Employer's Representative.

Three complete sets of Operating and Maintenance Manuals shall be provided. The Manuals shall be presented in the form of loose leaves contained in appropriate ring binders, lever arch files. The binders shall contain cardboard divisions between each section. A ready means of reference and a detailed index shall be included.

In the event of operating and maintenance instructions being unavailable at the time necessary for acceptance of the works as being practically complete, the Employer's Representative shall be empowered to employ any measures necessary for their production and to deduct the cost of such measures from payments applicable for completion of the works.

2.03.04 Progress and Completion Records

A progress record shall be maintained on site throughout the course of the works. The progress record shall include a set of working drawings together with other supporting documentation as may reasonably be required by the Employer's Representative.

The progress record shall be updated weekly to indicate the progress of the works to date. The record shall include marked up drawings with dates for completion of each section of the works and summaries of percentage completions for comparison with the Summary of Tender.

A project completions record shall be maintained on site throughout the course of the works. The project completions record shall comprise:

- * An index of all test certificates, commissioning certificates, insurance certificates and other documentation used to record witnessing and approval of all elements of the works, together with copies of all such documents;
- * A project completions schedule showing the dates on which each element of the works was completed.

The index of test certificates, etc, shall include an exclusive reference number for each certificate. This reference number shall be entered on the project completions schedule against the date for the relevant item.

The project completions schedule shall conform with the format shown in Appendix 2.01 of this Specification. A separate column shall be allocated on the schedule for each:

- * Item of plant;
- * Control Panel;
- * Distribution Board;
- * Lighting system, floor by floor, zone by zone, etc;
- * Power distribution system;
- * Fire alarm/security/public address/CCTV, etc, system or part thereof individually;
- * Lift/hoist/escalator;
- * Control system;
- * Pipework system;
- * Ductwork system;
- * Any other individual system or part system as may reasonably be required by the Employer's Representative.

The detailed format of the project completions schedule shall be submitted to the Employer's Representative for approval at the same time as the programme of works.

The relevant project completions record documents shall be completed before the works are offered as being practically complete.

The project completions record documents shall be included in the final issue of the record documents.

2.04 Contract Management

2.04.01 Site Visits and Meeting

The works shall include all necessary visits to the site for purposes of liaison, co-ordination, inspection and discussion, including attendance at regular site meetings and at other times as may reasonably be required by the Employer's Representative to suit particular circumstances.

2.04.02 Defects Liability

The defects liability period for the works shall be twelve months, commencing from the date of Practical Completion.

All defective materials, defective workmanship of items of outstanding work listed at the time of Practical Completion shall be dealt with within fourteen days or other reasonable period as may be agreed by the Employer's Representative.

Any faults or defective items becoming apparent during the defects liability period shall be dealt with within fourteen days of notification being given.

All defective materials or workmanship listed at the end of the defects liability period shall be dealt with within fourteen days.

In the event of an unreasonable period of time elapsing before defective or outstanding items are dealt with, the Employer's Representative shall be empowered to arrange for such items to be carried out by other parties and to deduct all associated costs from payments due under the Conditions of Contract.

2.04.03 Testing

General

All electrical engineering disciplines shall be tested and commissioned in accordance with relevant CIBSE Commissioning Codes and British/European Standards.

The Contractor shall agree a programme for pre-commissioning checks, setting to work, commissioning and performance testing with the Contractor.

Where required, the Contractor shall provide formal Method Statements supported by Risk Assessments detailing all commissioning and testing procedures.

The Contractor shall provide all necessary facilities to enable tests to be witness and inspections carried out on site or at the manufacturer's works.

All required personnel, including manufacturer's representatives shall be present and their activities co-ordinated.

Testing of all equipment and systems shall be undertaken as detailed in this specification. Should an inspection or test fail, the Contractor shall repeat the procedure until a satisfactory result or conclusion is obtained.

The testing of the electrical engineering services shall be completed prior to decoration of the building fabric and before services are concealed about ceilings or within risers. Testing shall be undertaken

during suitable environmental conditions to avoid harmful internal and external conditions affecting the procedure and test instruments.

All test equipment shall be subject to a quality assurance procedure complying with BS EN 30012-1.

Any testing that is to be completed outside of normal working hours shall be included by the Contractor.

Test Certificates shall include the following details as appropriate:

- * Project name and details of system or installation under test;
- * Date and duration of test;
- * Reference of any standard, code of practice or specification delineating applicable parameters;
- * Normal working conditions, e.g. of pressure, voltage, resistance, etc, of element under test;
- * Actual conditions witnessed during the test.

Evidence shall be provided at the request of the Employer's Representative to verify the accuracy and suitability of all instruments and methods of use in tests.

At least seven days notice shall be given of any tests that will require the presence of the Employer's Representative.

The works shall be tested in sections to suit the programme of work and the need for ensuring that all tests are completed before the relevant section is concealed by backfilling, insulation, duct covers, suspended ceilings or any other items that could restrict access. Any means of concealment put in place before testing is carried out shall be removed at the discretion of the Employer's Representative.

Notice of Tests

The Contractor shall provide two weeks notice to the Engineer and Client's Agent of intention to carry out inspection and testing and state any requirements for the attendance and co-operation of others.

The Client's Agent will witness test proceedings, verify results and determine if the specified requirements have been satisfied.

If following a test or inspection any system or part thereof is shown to be defective or not conforming to this specification, the Client's Agent will reject such defective parts by written notice within reasonable time, indicating area of dispute.

Test Records

Whether or not the inspection and tests are witnessed by the Engineer or his representative, the Contractor shall proceed with the inspection and testing of the installation on the agreed dates and shall fully record and certify the results obtained on Forms of Completion and Inspection Certificate as prescribed in the IET Regulations for Electrical Installations.

A copy of all test and commissioning record sheets and certificates shall be issued to the Engineer within 14 days of the completion of inspection and testing.

It should be noted that a Practical Completion Certificate will not be issued until the correct Test Certificates are duly completed and accepted by the Engineer.

2.04.04 Commissioning, User Tuition and Handing Over

General Requirements

All necessary arrangements and facilities shall be made available for the Employer's Representative to witness and approve commissioning.

Detailed records shall be provided of all commissioning procedures. Copies of commissioning records shall be provided initially for approval and subsequently included in the Operating and Maintenance Manuals, together with other completions records.

Inclusion in Programming of Work

Realistic provision for pre-commissioning, commissioning and user instruction shall be included in the programme of work, as described elsewhere in this Specification.

Pre-Commissioning

All necessary installation work, testing and approvals/ witnessing thereof shall be completed before any commissioning procedures are commenced.

Due notice shall be given to the Employer's Representative of the dates for pre-commissioning activities and for relevant approvals/witnessing thereof.

Pre-commissioning activities shall include:

- * The construction, installation and testing of associated installations;
- * All necessary static tests, adjustments and inspections of all elements of the relevant installation;
- * Cleaning of all systems and equipment internally and externally, including strainers and filters;
- * The issuing of relevant certificates in accordance with a format agreed with the Employer's Representative.

Commissioning

Commissioning shall comprise the process of transforming an installed system or item of plant from a state of static completion into full working order, including all necessary measuring, balancing, regulation and adjustments.

All recommendations of appropriate IET Regulations and CIBSE commissioning codes shall be complied with.

All plant, systems and equipment shall be fully commissioned before being offered to the Employer's Representative as being practically complete.

The works shall include all necessary provision for the attendance of the Manufacturer's Representative for the commissioning of each item of plant and specialist systems or equipment.

The works shall include the provision of all tools, instruments and other equipment necessary for commissioning. Evidence shall be provided as required by the Employer's Representative to verify the accuracy and suitability of all instruments and methods used in commissioning.

Commissioning shall be carried out by personnel specialising in such activities.

Commissioning Records

In the course of agreeing the programme of work, a detailed method statement for each commissioning activity shall be submitted to the Employer's Representative for approval.

All commissioning records shall be approved by the Employer's Representative before being included in the completions record documents.

Commissioning records shall include details of initial and final readings of all measurements taken, together with all relevant information to confirm that the installations have been set to work within the operating tolerances specified or otherwise laid down in the commissioning codes.

User Instruction

When the Employer's Representative has confirmed that the works or relative sections thereof have been commissioned and before the works are offered as being practically complete, full instructions shall be given to the Employer's operatives on the correct, safe and efficient operation and maintenance of all associated systems, plant and equipment.

Adequate time shall be allocated to enable the Employer's operatives to understand the complexities of the systems and to learn the necessary procedures for their operation and maintenance.

User instruction shall include an appraisal of all activities recommended in the Operating and Maintenance Manuals.

User instruction shall include an appraisal of the as fitted drawings.

Evidence of user instruction shall be provided to the Employer's Representative in the form of summaries of topics covered and dates of instruction. The summaries of instruction shall include a record of the person(s) instructed and the confirmatory signature of one of these under instruction.

Fuel of Commissioning

The works shall include provision for all necessary fuel and power for commissioning.

Seasonal Commissioning

The Contractor shall include the following seasonal commissioning responsibilities over a minimum 12 month period, once the building becomes occupied:-

1. Building services tested under full load conditions.
2. Testing shall be undertaken during a period of extreme (high or low) occupancy.
3. Interviews with building occupants shall be undertaken to identify problems or concerns relating to the effectiveness of the systems.

4. Recommissioning of systems (following any work needed to serve revised loads) shall be required, incorporating any revisions in operating procedures into the O&M Manual(s).
5. Lighting shall be reviewed at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.
6. Recommissioning of systems shall be undertaken following the review, incorporating any relevant revisions in operating procedures into the O&M Manual(s).

2.04.05 Builders Work

Builders work shall be excluded from the engineering services installations whenever a particular specification or the Conditions of Contract make provision for builders work to be carried out by the Building Contractor.

Builders work shall include:

- * Concrete and brickwork foundations or bases for plant and machinery;
- * Structural steelwork (excluding supporting steelwork integral with the works);
- * Cutting holes, pockets and chases and making good in walls, floors or ceilings;
- * Building in of rag bolts and other fixings;
- * Cutting and removing floorboards, skirtings and other joinery and making good;
- * The excavation and backfilling of trenches;
- * The formation of services ducts and shafts and the provision of covers thereto;
- * The provision of access panels in walls, floors, ceilings, services ducts/shafts, boxings or elsewhere as necessary.

The works shall include the provision of all information necessary for the execution of the associated builders work. This shall include fully dimensioned working drawings for plant bases, holes or pockets formed in concrete structures, access panels and major holes in brickwork or other masonry structures. It will be acceptable for minor holes and chases in brickwork or other masonry to be marked on site, subject to the agreement of the Employer's Representative.

Proposals for holes through concrete shall be approved by the Employer's Representative before the concrete is cast.

The accuracy of the locations, levelling and dimensions of all builders work shall be verified before subsequent installation of the works. Verification shall not involve the Employer's Representative.

Details of all builders work requirements shall be submitted to the Employers Representative and approved by him before the work commences. Any instructions for builders work shall be confirmed to the builder by the Employer's Representative.

Builders work shall not include the drilling of holes for screw fixing, expanding bolts, etc. Such activities shall be deemed to be included in the works in all circumstances.

2.04.06 Dimensions and Setting Out

Accurate dimensions shall be taken on site as necessary to ensure that works are correctly co-ordinated and integrated with all elements of the site, buildings, other services and any other relevant features.

The works shall be set out in accordance with details on the working drawings.

2.04.07 Drying out the Building

No part of the works shall be used for drying out the building, except under the following conditions:-

Detailed written proposals shall be submitted for approval at least seven days prior to the proposed commencement of the operation.

Such proposals shall designate which sections of the works will be operated and the measures to be implemented to ensure that the works be handed over in good condition.

Any deleterious effects arising from the operation of the system shall be made good before the system is offered for inspection prior to Practical Completion.

No additional costs shall be attributable to the Employer for any work associated with drying out the building.

2.04.08 Programme of Work

A programme of work shall be provided and agreed in good time to enable the progress of the works to be properly incorporated into a co-ordinated programme for the whole project.

The programme of work shall be prepared with due cognizance of all relevant factors, including:

- * Delivery of materials;
- * The need for co-ordination with other services installations and other trades;
- * Required dates for the availability of mains services;
- * The time required for witnessing and inspection of the works;
- * The time required for the preparation and approval of the working drawings;
- * The time required for commissioning;
- * The time required for the preparation of and approval of as fitted drawings and Operating and Maintenance Manuals;
- * The time required for instructing the Employer's operatives in the operation and maintenance of the works.

The programme of work shall be accompanied by sufficient details to enable the Employer's Representative and other interested parties to confirm that the programme is realistic in terms of resources required for co-ordination, inspection, witnessing, certification, etc.

The Employer's Representative shall be notified immediately in the event of any circumstances arising that could jeopardise the progress of the works. Such circumstances would include extended delivery of materials, industrial disputes, etc.

2.04.09 Precautions against Damage or Theft

The works shall be deemed to include all costs associated with all necessary precautions against damage or theft of materials and property used in connection with the works or belonging to persons employed in connection with the works.

2.04.10 Plant and Tools

The works shall include all necessary scaffolding, ladders, hoisting equipment and other apparatus for the supply, delivery, positioning and erection of materials, except where alternative provision is specified in the contract documents.

The works shall include the provision of all necessary plant, tools, transformers, control devices and associated cabling.

All necessary measures shall be employed to ensure that plant, tools, cabling and other apparatus are used in a safe manner and in accordance with appropriate regulations.

No item of plant, machinery or other apparatus shall be retained on site unnecessarily after completion of the activities for which it was required.

2.04.11 Services for the Works

The works shall include provision for the use of water, electricity and any other services necessary in the execution of the works, except where the particular Specification or the Conditions of Contract state otherwise.

2.04.12 Travel and Expenses

The works shall include all associated costs involved in transporting personnel to the site or other place, together with the payment of all relevant expenses or allowances.

2.04.13 Samples

Samples of materials and goods to be incorporated into the works shall be provided as required for approval by the Employer's Representative.

Samples shall be provided when required to suit the programme of work.

2.04.14 Trade Customs and Practice

Local Agreements

All necessary provision shall be included in the works for compliance with any local agreements for additional payments or other compensatory measures that may be attributable to any persons employed to execute any part of the works.

Demarcation

All necessary provision shall be included in the works for compliance with any agreement in effect requiring that any part of the works be carried out by persons qualified or otherwise certified to ply a particular trade.

2.04.15 Overtime

The works shall be deemed to include all overtime working necessary for any of the following reasons:

- * The time allocated in the programme of work;
- * Any requirements of enforcement authorities for large items of plant or other materials to be delivered or erected at a time to suit traffic or other conditions;
- * The need for working outside normal hours in occupied premises;
- * The need for maintaining existing services during normal working hours;
- * Any other foreseeable circumstances.

Prior notification shall be given to the Employer's Representative for any instances of overtime working.

In the event of overtime being necessary, as the result of unforeseeable circumstances, the Employer's Representative shall be requested in writing to issue an instruction to proceed. Any payments for premium time shall be related to records conforming with relevant requirements specified for daywork sheets.

2.04.16 Publicity and Advertisements

No photographs, articles for publication or any advertising material containing references to any part of the works shall be published without the express permission of the Employer's Representative in writing.

No trade signs shall be erected on or adjacent to the site without the prior approval in writing of the design and location.

2.05 General Technical Requirements

2.05.01 Maintenance

The works shall include the provision of comprehensive maintenance and servicing for a period of twelve months from the date of Practical Completion.

During the twelve month maintenance period, all inspections, adjustments, lubrication, replacements and other activities shall be carried out in accordance with the recommendations included in the approved Operating and Maintenance Manuals.

The twelve months maintenance work shall be carried out as a separate contract, following completion of the works.

The cost of the maintenance contract shall be shown as a separate item on the Summary of Tender and included in the Tender Price. The cost of the maintenance work shall be accounted separately from retentions under the Conditions of Contract and shall be payable quarterly.

The maintenance contract shall include the provision of all expendable items not covered by defects liability in the works.

2.05.02 Spares and Accessories

The works shall include the provision of all necessary spare parts and replacements including those listed below:

- * Three sets of keys for each panel, keyswitch, access panel/door/cover, padlock or other lockable item. Where keys are suited, at least one key shall be provided for each lock/switch, etc, plus two spares;
- * Three sets of keys/levers for each size and type of valve, cock, damper or other appropriate isolating or regulating device;
- * Three sets of fuses of each type and rating as appropriate;
- * One complete set of replacements for each air filter;
- * One complete set of belts for each belt drive;
- * One set of spares and expendable items as recommended in the Operating and Maintenance Manuals.
- * Luminaires – The Contractor shall include for the following quantity of luminaires of each type (ref) to act as spares.

Quantity of Luminaires Installed	Quantity of Spares
0-10	3
11-25	5
26-50	5
51-100	10
101-250	10
251+	20

2.05.03 Nameplates and Identification Plates

Nameplates

All items of plant shall be provided with a brass nameplate engraved with the maker's name, serial number, model reference or number, duty, absorbed power/fuel rate, output power, working pressure, test pressure, fuel type, electricity supply and other relevant details as appropriate.

Identification Plates

Each item of plant and equipment shall be provided with an engraved identification plate bearing its reference number, name or other reference as designated in the Specification or on the drawings. Identification plates shall have letters and/or numbers of adequate size as appropriate for each case.

Plate Fixings

Nameplates and identification plates shall be fixed using screws, studs and rivets. Adhesives shall not be used.

Valve Labels

Each valve shall be fitted with an approved engraved label of "Ivorine" or similar laminated plastic. Valve labels shall be secured with a split ring.

Valve labels shall incorporate the relevant number conforming with the valve schedules and as fitted drawings. Each valve label shall clearly indicate the service and function of the valve.

Piped Services Identification

Piped services shall be identified in the manner described in the section of the Specification dealing with insulation and painting.

2.05.04 Electrical Equipment

Provision of Details

Sufficient details shall be provided for approval and to enable all electrical components of the works to be integrated with all other relevant electrical equipment. Such details shall include wiring diagrams, schedules and schematics specifically applicable to the works; 'typical' details shall not be accepted.

Details shall be provided of operating voltage, use/overload ratings, running and starting currents, locked rotor currents, earthing requirements and any other features relevant to the safe and efficient operation of the equipment.

All terminal references and equipment references on wiring diagrams and schematics shall conform with similar references shown on the drawings.

Motors

Except where alternative requirements are specified elsewhere, electric motors shall conform with British Standard requirements for super silent squirrel cage induction type; they shall be totally enclosed ventilated or screen protected and have sealed for life bearings.

Starters

Direct on line starting shall not be employed on any load above 5.5kW. Assisted starting shall be employed above 5.5kW.

Starters shall be metal clad or insulation surface pattern except where located inside a control panel having an integral isolator.

Three phase starters shall be of the three or four pole contactor type with phase failure protection, thermal and/or magnetic overload trips on each phase and no volt release.

Starters shall be suitable for push button operation except where specified elsewhere.

Where remote control is required, auxiliary poles shall be incorporated to ensure complete isolation of the coil circuit.

Colour Coding of Alphanumeric Marking of Electrical Cables

All electrical cables shall carry the new Harmonised colour / alphanumeric coding as defined by BS 7671.

For refurbishment work or where extensions to an installation occur the contractor shall refer to table 7E (appendix 7) of the regulations which specifically addresses the marking at the interface between old and new installations.

Electricity Supply

All electrical equipment shall be suitable for use with a 400 volt, 50Hz, three-phase and neutral alternating current electricity supply, except where difference requirements are specified elsewhere. This requirement does not preclude the use of single phase motors rated at 1.0kW or less.

2.05.05 Interruption of Existing Services

The agreement of the Employer's Representative shall be obtained prior to the commencement of any work requiring the interruption of any existing service.

All necessary liaison shall be carried out with the owners and/or users of existing services and confirmed in writing before any work commences in connection with existing services.

Due compensation shall be paid to the Employer and/or owners/users for any claim arising from damage or disruption caused by failure to observe all necessary precautions in any section of the works involving existing services.

2.06 Site Management

2.06.01 Protection of the Works

All necessary precautions shall be taken during the execution of the works to prevent physical damage, dirt, corrosion, dampness, pollution or other detrimental occurrences to plant, equipment, wiring, pipework or other component parts. Such precautions shall include:

- * Temporary covers as appropriate;
- * The mandatory use of proprietary caps, plugs, blank flanges, glands or terminations or approved purpose made blanking pieces on open ends of pipework, ducts, etc;
- * The retention of factory applied wrappings on radiators, convectors, luminaires, control equipment, items of plant, etc, until other trades work involving potentially deleterious effects has been completed;
- * Storage of delicate components in a safe place until potentially damaging activities have ceased in or adjacent to the final location of such components;

- * The use of adequate storage containers, racks, etc, in the periods between delivery and erection;
- * Protection against frost;
- * Any other reasonable measures as may be considered necessary by the Employer's Representative.

All necessary measures shall be implemented to prevent any element of the works from being misused, e.g. as temporary support, means of access or scaffolding or for any purpose other than that for which it was designed.

The Employer's Representative shall refuse to accept equipment:

- * That has evidence of damage, deterioration or other deleterious effects;
- * That is suspected of having suffered deleterious effects resulting from the absence of suitable protective measures.

If the Employer's Representative has reasonable grounds to believe that adequate protective measures have not been employed, all necessary means shall be implemented to demonstrate that no deleterious effects have occurred. Such means shall include:

- * Rodding, pigging or dismantling of pipework;
- * Additional testing of cables or pipework;
- * Removal of ceilings, duct covers or any other element of the building;
- * Uncovering of services in trenches;
- * Making good to any part of the building, services or external works made necessary as a result of demonstrating that no deleterious effects have occurred;
- * Any other measures as may be required to suit the particular circumstances.

2.06.02 Delivery of Materials

The works shall include all relevant provision for packaging, carriage and delivery of all necessary materials to the site.

Materials shall be delivered to site as required to suit the programme of work.

All surplus or redundant materials and packaging shall be removed from the site immediately.

2.06.03 Unloading and Storage of Materials

The works shall include all costs associated with the unloading, storage, hoisting, distribution and placing in position of the materials used, except when alternative provision is specified in the Contract Documents.

Track laying vehicles shall not be allowed onto any part of the structure without the express written permission of the Employer's Representative.

Written permission shall be obtained from the Employer's Representative before any bulk storage of materials is allowed on any part of the structure.

2.06.04 Site Accommodation

The works shall include provision for site offices, storage sheds, workshops and other accommodation necessary for the execution of the works, except where the Particular Specification or Conditions of Contract state otherwise.

Site accommodation shall be deemed to include any necessary provision for electrical supplies.

Site accommodation shall include toilet and messing facilities appropriate to the number of persons employed in the execution of the works, except where the Conditions of Contract include for alternative provision of such facilities.

2.06.05 Cleanliness of Site

All surplus and redundant materials, scaffolding, packaging and other items shall be removed from the site during the course of or on completion of the works as appropriate.

Care shall be taken throughout the course of the works, to ensure that materials in use, surplus materials and rubbish shall not present any hazard or obstruction to the movement of personnel or plant.

2.07 Quality Management

2.07.01 Materials and Workmanship

Compliance with the Specification

Materials and the standard of workmanship employed in the execution of the works shall comply with good practice and shall comply with all relevant requirements of the Specification, except where the written approval of the Employer's Representative has been given in advance, for compliance with an alternative requirement.

Difference materials from those specified shall be subject to prior approval and shall be accepted only when there are benefits either: to the Employer, in terms of quality or cost; or to the progress of the works. No additional costs shall be attributable to the Contract for any reason in connection with changes made to the Specification, in order to assist in meeting the programme of work.

Deleterious Materials

Without prejudice to the generality of Clause 7.1.1 all reasonable skill and care shall be used to see that, unless authorised by the Employer's Representative in writing or, where such authorisation is given orally, confirmed to the Employer's Representative in writing, none of the following has been or will be used in the construction:-

High alumina cement in structural elements;

Wood wool slabs in permanent formwork to concrete;

Calcium chloride in admixtures for use in reinforced concrete brickwork or blockwork;

Asbestos products;

Naturally occurring aggregates for use in reinforced concrete which do not comply with British Standard 882 : 1983 and/or naturally occurring aggregates for use in concrete which do not comply with British Standard 8110 : 1985;

Urea formaldehyde in cavity wall insulation;

Sand lime brickwork;

Wood preservatives or paints containing pentachlorophenol (PCP);

Insulation materials formed with chlorofluorocarbons (CFC's);

Tropical hardwoods from non-sustainable sources.

Rejection of Materials or Workmanship

All necessary facilities shall be made available to enable the Employer's Representative to inspect any materials and workmanship as required. This shall include inspections of materials at the Manufacturer's works, in store, during the installation or after installation as appropriate.

The Employer's Representative shall be empowered to reject at any time any materials or workmanship that do not comply with all requirements of the Specification.

Any rejected materials or other part of the works shall be removed and replaced in compliance with requirements of the Employer's Representative.

No claims for loss, expense, delay nor any other reason shall be based on failure to complete any section of the works as a result of materials or workmanship having been rejected for non compliance with specified requirements.

Approved Deviations

The works shall include all items as specified except where the Employer's Representative has given written agreement for the acceptance of alternative requirements.

Where the Specification includes such terms as “or equal and approved”, “or equivalent”, “or similar approved type”, such alternatives shall only be deemed appropriate after the approval of the Employer’s Representative has been given. Such approval shall be given in writing either:

- * Where the Conditions of Tender so allow, as acceptance of an offer included in the tender for an adjustment of the tender figure, or;
- * After the tender has been accepted, as an instruction issued in accordance with the Conditions of Contract.

2.07.02 Uniformity

All components having the same function shall be of the same type and interchangeable where relevant.

All components shall conform to relevant requirements of current British Standards and corresponding ISO or CEN standards with respect to sizing and compatibility.

Except where otherwise stated, all screw threads on nuts, bolts, studs and rods shall conform with metric standards.

Names, numeric and alphanumeric identifications of plant and equipment on labels, working drawings, as fitted drawings, schedules, operating instructions and any other location shall be consistent and in accordance with a logical format.

2.07.03 Workmanship and Quality Benchmark Room

The sub-contractor shall supply and install a fully fitted out example area in collaboration with the main contractor which shall act as a quality and installation methodology benchmark for sign off by the client. The area in question shall be agreed with the project design team and the client prior to first fix installation initiation. The client shall then review the installation and sign off the quality aspect for the electrical and mechanical sub-contractors to benchmark installation quality throughout the project. The installation shall align with the requirements specific to the space and include evidence (not limited to) of support and fixing methodologies complete with QR codes associated with the individual products present, and example approved fire -stopping installation in-line with the relevant substrate. The benchmark room will reflect installation methodology and quality with sign off associated with these elements only, wider products utilised shall follow the project technical specification and be subject to a full technical review.

2.07.04 Workmanship and Supervision

All elements of the works shall be carried out in a neat and workmanlike manner.

The works shall be deemed to include all necessary provision for the employment of competent personnel in management, supervisory, skilled and unskilled capacities.

A manager, foreman or other technically qualified and competent persona shall be nominated and be retained on site throughout the course of the works. This manager shall be fully conversant with all aspects of the works and shall be responsible for liaising with an accepting instructions from the Employer’s Representative.

Supervision of the works by the manager/foreman shall include all necessary inspections and ‘snagging’ to ensure that all elements of the works are completed and to an acceptable standard before being offered to the Employer’s Representative for inspection.

2.07.05 Vouchers

Invoices, accounts or other documents as appropriate shall be provided as required by the Employer's Representative as proof that any materials incorporated in the works are in full conformity with specified requirements.

2.07.06 Cleaning

The whole of the works shall be thoroughly cleaned as required by the Employer's Representative before being offered as being practically complete.

Cleaning of the works shall include:

- * Removal of all superfluous plaster, paint, excess jointing material, grout and any other debris;
- * Making good to decorations or other finishes after removal of superfluous materials;
- * Removal of dust/grime from luminaires, diffusers, polished/chrome or other bright metal finishes, gauge glasses, instrument faces, etc.

Cleaning shall include the interiors of all plant, panels and other relevant equipment.

Cleaning shall include the interiors of all services ducts, trunking, shafts or other concealed locations.

2.08 Cost Management

2.08.01 Schedule of Quantities and Rates

Within fourteen days of the issuing of the instruction to proceed with the works, or at such other time as may be required by the invitation to tender or Conditions of Contract, a fully priced schedule of quantities and rates shall be submitted to the Employer's Representative.

The schedule of quantities and rates shall show the quantities of each item of plant and equipment included in the tender together with the installed rate for each, including the cost of the material, labour and expenses, profit and discounts.

The schedule of quantities and rates shall be divided into sections in conformity with the Summary of Tender. The total for each section and the grand total shall conform with the prices shown in the Summary of Tender.

The schedule of quantities and rates shall be used in determining the cost of any variation to the works involving additions or omissions of quantities.

At the discretion of the Employer's Representative, the Schedule of Quantities and Rates may be used in determining interim valuations.

2.08.02 Variations and Additional Information

Instructions

The Employer's Representative may at his discretion issue instructions relating to variations in requirements of the Specification or giving additional information relative to specified requirements. All such instructions shall be issued using a standard form of instruction, e.g. Architect's Instruction and in accordance with the Conditions of Contract.

Circumstances may arise whereby decisions made on site need to be implemented before sufficient time has elapsed to enable a formal instruction to be issued. In such cases, the Employer's Representative shall issue an interim written instruction, e.g. a Site Instruction, at the time of making the decision. Requirements of such instructions shall be implemented on the understanding that a formal instruction will be issued in confirmation.

Adjustment of Costs

Where the requirements of a formal instruction constitute a variation to the scope of the works, any adjustment of costs shall be determined in accordance with Conditions of Contract.

Adjustments to the cost of the works shall be evaluated in accordance with one of the following methods, as appropriate and as directed by the Employer's Representative:

- * Where the variation involves an addition or reduction in the quantities of materials installed, the costs shall be calculated using the Schedule of Quantities and Rates;
- * Where the variation involves the provision of significant quantities of plant and materials of a type not included in the Schedule of Quantities and Rates, a separate quotation shall be submitted;
- * Where the variation involves modifications to existing installations or to materials already installed, the costs shall be either subject to a quotation or measured as daywork and based on the time expended and materials used, as directed by the Employer's Representative.

Quotations

When the Employer's Representative directs that a quotation is applicable, the make up of the quotation shall be fully quantified and a schedule of rates provided to demonstrate that the costs are reasonable and consistent with the level of pricing applicable to the Tender.

Daywork

Daywork shall only be applicable when the Employer's Representative so directs in writing.

Daily records shall be maintained on site of all time, materials and plant used in the execution of dayworks. Weekly records shall be submitted to the Employer's Representative for signature not less than seven working days after the end of the week in question. Copies of signed daywork sheets shall be issued to the Employer's Representative:

- * At the time of signature and;
- * Together with any application for payment in respect of that work.

Daywork sheets shall serve only as a record of the work involved in a particular activity. The signing of a daywork sheet shall not be construed as an instruction nor any indication as to whether the work constitutes a variation to the scope of the works.

Payment of Variations

Any application for payment for additional works shall include a list giving the following information for each variation:

- * Instruction number;
- * Brief description of work;
- * Submitted cost, or failing this, an interim budget cost or, where appropriate, the agreed cost;
- * Percentage of the work completed to date.

In the absence of a fully documented application, any payments for additional work completed shall be entirely at the discretion of the Employer's Representative.

2.09 Building Services Log Book

The Contractor shall, at the completion of the works, provide a Building Log Book to be used by the end user. The log book shall follow the guidance in CIBSE TM31 "Building Log Book Toolkit". It shall be issued to the Engineer in draft form for inspection one month prior to completion and shall be returned by the Engineer no later than five working days following receipt.

Handover will not take place without the final approved document being in place.

3.0 STANDARD ELECTRICAL SPECIFICATION

3.01 Regulations, Standards and Workmanship

The Contractor shall employ fully competent tradesmen of appropriate grades under the direct control of an experienced supervisor.

The whole of the works shall conform to the best principles of modern practice and comply with all relevant regulations and standards current at the date of Tender and in particular the following:-

- a) The Regulations for Electrical Installations, including any amendments, issued by the Institute of Electrical Engineers (the IET Regulations).
- b) The Regulations under the Factories Act and Health and Safety at Work Act, 1978 including the Memorandum on the Electricity Regulations.
- c) The Requirements and Regulations of the Electricity Supply Authority.
- d) The Requirements of any local by laws.
- e) The Requirements of the current editions, including any amendments, of all relevant British Standard Specifications (BSS) and British Standard Codes of Practice (BSCP).
- f) The Requirements of the Employer.
- g) The Requirements of all other applicable statutory, mandatory or advisory standards or regulations.

The Contractor shall include for all material, labour, work, sundry items, etc required to comply with the above regulations and standards.

3.02 Inspection, Testing and Commissioning

The whole of the electrical works shall be inspected, tested and commissioned in an orderly sequence in accordance with this Specification, the IET Regulations, British Standard Codes of Practice, etc. Generally, the inspection, testing and commissioning shall be a continuous process. It shall be progressive as work proceeds with the Engineer carrying out visual inspections and witnessing testing. No work shall be covered up or otherwise concealed until approval has been given by the Engineer.

All equipment, materials, labour, etc required for testing and commissioning shall be provided by the Contractor.

When the Contractor is satisfied that the works, or sections of the works, are complete and ready for testing, he shall notify the Engineer in writing giving a minimum of seven days notice. The works shall then be tested and demonstrated in the presence of the Engineer to show the following:-

- a) Compliance with this Specification and other contract documents.
- b) Compliance with the regulations, standards and workmanship detailed in this Specification.
- c) Ability of the works to perform correctly under all conditions of service.
- d) Correct settings of all controls, overloads, trips, etc.

- e) Correct functioning of equipment.
- f) All visual displays operate correctly.
- g) All interconnections with other systems are complete and functional.

The Contractor shall perform all tests required by the IET Regulations, British Standard Codes of Practice, etc. Completions and Test Certificates, signed by the Contractor, shall be submitted, wherever possible use the format suggested in the IET Regulations (e.g. earth loop impedance, insulation resistance, earthing, Completion Certificate, etc). For other systems, full details of the testing and commissioning results shall be entered on sheets of appropriate format.

Where equipment or materials are routine tested at the manufacturers works, the Contractor shall submit to the Engineer two copies of all routine and type Test Certificates. Faulty materials or workmanship found during inspection, testing or commissioning shall be removed and replaced by the Contractor at his own expense.

3.03 Materials

All materials shall comply fully with the requirements of the appropriate British Standard Specification.

The Engineer reserves the right to inspect materials either on site or at the manufacturer's works at any reasonable time and to reject any material which does not comply with this Specification. The cost of any dismantling, reassembly, removal or retesting as a result of rejection by the Engineer shall be at the Contractor's expense.

The Contractor shall obtain and check all quotations from manufacturers and suppliers to ensure that all incidental work, equipment, accessories and sundry items required for the proper functioning of the equipment are included. If any items are missing from manufacturers or suppliers quotations, the Contractor shall be responsible for supplying such items and for including all necessary costs in his Contract Price.

The Tenderer shall ascertain that all materials, including those specified by the Engineer, can be procured at the proper times to meet the required programme dates. If any material cannot be so procured, the Tenderer shall offer alternative and equal material. The Tenderer shall submit full details, Specifications, brochures, data sheets, etc to enable the Engineer to fully evaluate alternative materials offered.

3.04 Cables

3.04.01 Colour Coding of Alphanumeric Marking of Electrical Cables

All electrical cables shall carry the new Harmonised Colour / Alphanumeric Coding as defined by BS 7671.

For refurbishment works or where extensions to an installation occur the contractor shall refer to table 7E (Appendix 7) of the Regulations which specifically addresses the marking at the interface between old and new installations.

3.04.03 XLPE/SWA/LSF Cables

Cables shall be multicore, copper conductor, XLPE insulated, bedded, steel wire armoured, LSF sheathed overall, 600/1000 volt grade in accordance with BS 6724.

Fixings shall be by means of claw type cleats with plated nuts and bolts suitable for indoor or outdoor use.

Cables shall be terminated using compression type cable sockets and brass glands. All glands shall be fitted with PVC shrouds and be suitable for indoor and outdoor use. All fixings/supports/clips shall be of metallic material.

Earthing between the cable armouring and equipment shall be by means of brass earthing tags fitted to the cable gland. The earthing conductor shall be sized in accordance with the IET Regulations and be connected at the time of cable termination.

The cables shall be installed and terminated in accordance with the IET Regulations and the manufacturer's recommendations. Cables shall not be installed when the ambient temperature is below 1°C. Particular care shall be taken to avoid damage to other services which may run adjacent to or across cable routes. A minimum of 150mm shall be maintained between cables and other services.

Direct buried cables shall be laid at a minimum depth of 500 mm on a 75 mm bed of sand. Cables shall be covered by a further 150 mm layer of sand or sifted soil and protected by interlocking concrete cables tiles embossed "DANGER ELECTRICITY". Yellow plastic warning tape shall be installed 150 mm above the cable tiles.

Where cables pass under roadways or buildings they shall be protected to a minimum heights of 600 mm by galvanised steel channelling.

3.04.04 LSF insulated Cables for Use in Conduit and Trunking

Cables shall be single core, copper conductor, LSF insulated, 450/750 volt grade in accordance with BS 7211.

Conductors up to 2.5 sq mm may be solid. Larger sizes shall be stranded.

The insulation shall be coloured in accordance with the IET Regulations. Additional identification shall be provided where cables are used for specialist systems. LSF insulated cables shall not be routed through fluorescent fittings or near tungsten fittings and other high temperature equipment. In these instances, heat resisting cable shall be used.

3.04.05 MICC Cable

MICC cable shall be LSF sheathed, 1000 V grade, heavy duty type, unless specified otherwise, in accordance with BS 6207. Cable and accessories shall be from the same manufacturer.

Cables shall be made off using cold pot type seals, neoprene sleeving and ring type glands in accordance with the manufacturer's recommendations.

Where cables are surface mounted on walls, etc, or installed on cable trays, they shall be fixed by means of single or multiway PVC coated copper saddles secured with brass screws. All cables shall be neatly dressed in a symmetrical manner and no cable shall be bent to a radius less than six times its overall diameter or the manufacturer's recommendation, whichever is the greater.

The maximum spacing for fixings shall not be greater than the following:

a)	Surface or cable tray installation	:	300 mm
b)	Ceiling voids and other concealed areas	:	600 mm
c)	Buried in plaster work	:	450 mm

Under no circumstances shall cables be run through metal conduit or installed as to be in contact with pipework or other services without written approval of the Engineer.

Cables shall be installed in one length and the individual cores shall be identified by coloured or lettered sleeves.

At cable terminations a sufficient length of straight cable shall be provided before forming any set or bend to facilitate removal of the termination after installation of the cable.

Cables rising from below grade shall be protected to a height of 900 mm by galvanised steel channelling. Where cables are buried in wall finishes, they shall be protected by plastic channelling.

The Contractor shall ensure that all ends of cables are sealed immediately after cutting to prevent the ingress of moisture.

Cables shall be tested before and after installation and readings of "infinity" obtained.

3.04.06 General Pliable Fire Performance Cable Specification Cable Section

a) Pliable Multicore Circuit Integrity Cables-300/500 Volts

All cables shall be Firetuf, manufactured by Delta Crompton Cables in Accordance with BS 7629 and shall be served with an OHLS (Zero Halogen Low Smoke) sheath.

The manufacturer shall hold BASEC approval (British Approvals Service for Cables) for the products they manufacture and supply and in addition, be approved by Quality Assurance standard BS EN ISO 9002.

The manufacturer shall hold LPCB (Loss Prevention Certification Board) approval for the products they manufacture and supply.

The fire performance of cables shall comply with BS 6387 categories C,W,Z.

Pliable cables shall have an outer sheath covering of red for fire alarms and white for emergency lighting, other colours are however available. The overall sheath shall be low smoke and halogen free thermoplastic, unless otherwise specified.

Screening will be achieved by using an aluminium polyester laminated tape which will be in constant contact with a tinned earth conductor.

Fire integrity will be achieved by the combined performance of a close weaved glass binder in conjunction with silicone rubber insulation on the cores. Conductors shall be either solid or stranded plain annealed copper to BS 6360.

Firetuf cables shall have a twisted core configuration comprising of 10 twists per metre to improve signal transmission characteristics.

Pliable cables selected must comply with BS 4066 Part3/IEC60332 Part 3/HD405.3 Categories A,B,C- Flame Propagation.

b) Glands and Fixings

In normal conditions of use, entry to fittings should be through a zero halogen low smoke polymeric or type A2 brass gland. These components must be supplied by the same manufacturer as the cable itself.

Where pliable cables are fixed direct to the building fabric, purpose designed coloured (zero halogen low smoke) OHLS coated copper 'P' clips supplied by the same manufacturer as the cable must be used to ensure the fire survival properties of the installation.

The maximum distance between fixings is dependent on the size of the cable and shall not be greater than that specified in the tables below, unless permission is specifically granted by Delta Crompton Cables:-

Table One - Surface Fixed

Overall Diameter of Cable (mm)	Max. Spacing of Fixings	
	Horizontal (mm)	Vertical (mm)
Not exceeding 9mm	250	400
Exceeding 9mm and not exceeding 15mm	300	400
Exceeding 15mm and not exceeding 20mm	350	450
Exceeding 20mm and not exceeding 40mm	400	500

Table Two - Tray Fixed

Maximum Spacing * depending on installation	Horizontal mm	Vertical mm
Subject to compliance with local regulations	700	900

c) Installation Procedure

The Contractor shall ensure that his workmen are fully conversant with and are skilled in the installation of pliable cable

All bends shall be neat and uniform and their radius shall not be less than six times the diameter of the cable

After both ends of the cable have been made off, the cable shall be tested for continuity and short circuits, in line with the IET Regulations (BS 7671).

Conductors carrying fire alarm power or signals require no segregation from other systems so long as cables meeting BS 7629 are utilised, as referred to in BS 5839:Part 1 Section Two 17.10.

Pliable cables shall be installed according to BS 7671 (IET Regulations) and in conjunction with the manufacturers recommendations.

3.05 Conduit Systems

3.05.01 General

No conduit smaller than 20 mm shall be installed and manufactured elbows, tees or bends will not be permitted. Bends required shall be formed, using a standard conduit bending machine, without unduly deforming the conduit section.

The distance between draw in points shall not exceed 4 metres. The cable capacities of conduits shall be determined in accordance with the IET Regulations. Conduits shall be sized to give easy draw in and withdrawal of cables and the use of French Chalk or other lubricants to ease the installation of cables will not be permitted. Draw wires shall be provided in all conduits left empty for future cabling.

Each section of the conduit system shall be completely erected and swabbed clear before any cables are drawn in.

The conduit system shall be arranged so that cables are drawn in only at lighting points, outlets, switches and easily accessible conduit or adaptable boxes.

Where the ends of conduits have to be left unterminated during building operations, conduit couplers and stop ends shall be fitted to protect the conduit threads. Similarly, temporary lids shall be fitted to all conduit boxes, etc. Wood plugs or packing with paper, rags, etc will not be acceptable.

Where conduits are concealed in plasterwork, screeds and structural concrete, etc, they shall have a suitable depth of cover. The cover shall be at least 12 mm in plasterwork and 32 mm in screeds and concrete unless specified otherwise. Where the top coats of plaster are liable to corrode steel switch or outlet boxes, etc they shall be painted with one coat of red oxide paint before installation.

The lids of draw in boxes concealed in plasterwork or behind ceilings shall be the overlapping type to adequately mask the joint between the box and the surrounding material. Where conduit boxes are concealed, the face of the box shall be flush with or recessed by not more than 6 mm. Extension rings shall be used for conduit boxes recessed by more than 6 mm.

Conduit boxes that are proud of the surrounding material shall be removed and reinstalled, or where practicable, ground down and the metalwork rust proofed as for damaged conduit.

Vertical conduits shall be run parallel to or perpendicular to walls and be erected in such a manner as to reduce mechanical stress to a minimum.

Conduits in concrete which cross expansion joints or similar features shall be wrapped on either side of the joint for a distance of 300 mm with two layers of Denso tape. Where a surface conduit crosses an expansion joint or similar feature, a length of flexible metallic conduit, not less than 300 mm long, shall be installed in the conduit run across the joint or feature. A separate earth continuity conductor, terminated in an approved manner, shall be provided to bond across the flexible connection.

Conduits shall be fixed at intervals via metallic fixings not exceeding those given in the IET Regulations. In addition, fixings shall be provided within 300 mm of each lighting point, outlet, switch or other boxes. All boxes used for supporting lighting fittings, switches, outlets or similar equipment shall be independently fixed. In general two conduit boxes shall be provided for supporting each fluorescent fitting.

Rigid conduit shall not be directly connected to pumps or other equipment liable to vibration. In such cases, the final connections to the equipment shall be made using flexible metallic conduit.

The making good around lighting, switch and outlet boxes shall be carried out before the fixing of accessories or lighting fittings.

The conduit systems shall be arranged so that the conductors of each circuit are installed in the same conduit. All conduit systems shall be arranged so that they are completely rewirable from the spaces served and be accessible in false ceilings, etc.

A separate circuit protective conductor shall be provided for each circuit installed in conduit systems.

3.05.02 Metallic Conduit Systems

Conduit and accessories shall be the galvanised, heavy gauge, welded steel type in metric sizes. All fittings, couplers and accessories shall be the screwed pattern.

Conduit fittings for external or other damp locations shall be weatherproof. Covers shall be fixed by brass screws in blind, tapped holes. The faces and covers of boxes shall be machined and greased.

For normal situations, circular boxes shall be the small pattern with two cover fixing lugs at 50.8 mm centres. Where boxes are to support fittings exceeding 7 Kg in weight, large pattern conduit boxes, with four cover fixing lugs, shall be used.

The interiors of cur conduit ends shall be reamed to remove burrs and sharp edges.

Conduit terminations shall be fitted with a brass male bush and conduit coupler, except where the conduit is terminated into fittings or equipment having tapped spouts. The use of ring bushes and locknuts will not be permitted. On bushed connections, a cadmium plated locknut shall be provided to ensure earth continuity.

Exposed threads shall not be permitted, except where runners are essential. The threads of runners shall be treated as for damaged conduit.

Where the finish of a conduit has been damaged or removed, the conduit shall be protected by two coats of red oxide and one coat of aluminium paint.

Conduit systems are not intended to be gas tight. Provision shall be made for drainage and the expansion and contraction of air. Conduits shall fall to boxes, etc, where provision shall be made for drainage of condensation.

The provision of earthing or bonding conductors installed in the conduit system shall not reduce the requirement for the conduits to be electrically continuous and bonded to the earthing system. The conduit shall be tested for continuity before earthing or bonding conductors are installed.

3.05.03 Non Metallic Conduit Systems

Where approved, conduit shall be circular section, high impact, heavy gauge, rigid PVC type in metric sizes. All fittings, accessories, components, etc shall be obtained from the manufacturer of the conduit.

Joints shall be made using adhesive specially manufactured for jointing non metallic conduit systems. Where conduits are cast in-situ, the joints shall be further protected by two layers of Denso tape to form a rigid, water proof joint.

Allowance shall be made in accordance with the manufacturer's recommendations for expansion in the conduit system.

Non metallic conduit shall be used for internal applications and only where the temperature will not drop below 0°C or rise above 60°C.

Bends in conduit shall be formed using springs. The recommendations of the manufacturer shall be followed in terms of methods, temperature, etc. Inspection bends, tees, etc will not be permitted.

For normal situations, circular conduit boxes with spouts shall be used. Where the weight to the support is greater than can be accommodated by normal conduit boxes, heavy duty boxes with metal straps and clips shall be used. In such cases, additional fixings to the building structure shall be provided as required. High temperature of metallic boxes shall be used where the temperature is likely to exceed 55 degrees centigrade.

The interior of all cut conduit ends shall be reamed or filed to remove burrs or sharp edges. Conduits which terminate at distribution boards or similar enclosures which do not have spouts shall be fitted with adapters and bushes.

3.06 Earthing and Bonding

The main supplies will be the PME type provided by the Electricity Authority. Earthing terminals will be made available by the Electricity Supply Authority.

The Contractor shall supply, install and connect a complete earthing and equipotential bonding system in accordance with the IET Regulations and the Electricity Authority's requirements for PME installations.

Protective conductors shall be covered in green/yellow PVC insulation, except where they are an integral part of a multicore cable, in which case they shall be sleeved in green/yellow insulations at the terminations.

Circuit protective conductors and bonding connections shall be sized in accordance with the IET Regulations. Main bonding connections shall be made directly from the main earthing bar in the LV Switchroom.

All earthing and bonding connections shall be made at accessible positions and be identified by permanently fixed labels embossed "safety electrical earth - do not remove". The labels and 500 mm of wiring shall be free from decorative finishes such as paint, plaster, etc. They shall be protected by tape or similar prior to the application of the decorative finish. The protection shall be removed when painting, plastering etc is completed. Alternatively, the connections shall be made to cleaned surfaces and the labels fixed after decorating, etc is completed.

Connections shall be made using bolted links, removable only by tools for testing purposes as required by the IET Regulations.

3.07 Labelling, Marking and Circuit Lists

In additions to any specific requirements detailed elsewhere, the Sub Contractor shall supply and fix the labelling, marking, circuit lists, etc as described herein:-

Every fuse switch, isolator, distribution board, etc shall be clearly labelled giving its title or designation, source of supply, function, voltage and phases. Labelling shall be in Ivorine letters with characters at least 10 mm high. On main distribution panels, the characters identifying the incoming supply shall be larger to distinguish it from outgoing feeders.

All socket outlets are to be labelled clearly with circuit reference as drawings.

Phase identification shall be clearly marked inside all equipment, including single phase equipment.

Each conductor shall have phase identification by sleeves in either hard plastic or rubber. Numbered or coloured conductors shall be used and whichever system is used shall be maintained throughout the installation.

Warning notices, complying with the IET Regulations, shall be provided on all equipment operating in excess of 250 volts.

Labelling and identification shall be provided on each conductor, at both ends, of all control wiring, contractor controls, time clock circuits, etc using plastic numbered or lettered ferrules.

Special attention to labelling is to be applied to the main switchboard.

3.08 Fixings

All fixings shall be metallic type to BS 7671.

Fixings to wood shall be by means of woodscrews.

Fixings to masonry shall be by means of woodscrews and rawlplugs or other equal and approved methods. Larger fixings shall be by means of rawlbolts or other equal and approved methods.

External fixings and fixings in damp situations or where class 4 conduit is used, shall be made using white bronze rawlplugs and sherdised screws or other equal and approved methods.

Cavity fixings shall be the compressing rubber sleeve or toggle types to suit the particular application.

The minimum size of woodscrew used shall be 3.8 mm No 8.

Fixings to steelwork shall be clamped using minimum 6 mm diameter metal threaded rod, nuts and bolts. For external situations or in damp conditions all fixings shall be galvanised. Drilling of steelwork will not be permitted.

A weight of 14 Kg shall be suspended from each lighting point on conduit systems (7 Kg in the case of other systems) before the fitted is erected. Should any movement occur then the fixing shall be either remade or additional fixings provided.

The Contractor shall supply and fix suitable adapter plates or other items to facilitate the suspension of trunking, cable tray, lighting fittings, etc as required.

3.09 Building Form, Restrictions and Requirements

The basic structure of the building may restrict the Contractor in the positioning and type of fixings. The spacing of fixings, clearances, etc shall be adjusted by the Contractor as required to suit the building structure. The Contractor shall ensure that the maximum spacing of fixings or minimum clearances from other services are in accordance with the requirements of this Specification and the manufacturers recommendations.

The Contractor shall include for all setting, bending, diverting, etc as required to clear all other services and architectural or structural components. This shall include the supply and installation of all extension rings. Extension pieced, brackets, supports or other such items as required.

The Contractor shall include for sufficient fixings or secondary steelwork to cater for the weight of the electrical services being installed.

3.10 Fire Stopping

All engineering services including cables, conduits, cable trunking, cable tray, cable basket, cable busbar, etc. passing through floors or fire compartment walls shall be provided with appropriate fire stopping material (sleeves, collars, blankets, pillows, etc.) built into the building fabric.

Refer to section 1.0 for further details and requirements.

3.11 Rubber Insulating Mats

The Contractor is to allow for the supply and installation of rubber insulating mats. These shall be placed along the full length of the LV switchroom in front of the main switchgear.

3.12 Spares

On completion of the works, the Contractor shall hand over the following:-

- Suitable quantity of spare luminaires – Refer to Section 2.06 and Electrical Schedules for details.
- Spare parts for the fire alarm system as recommended by the system manufacturer.

The Tenderer shall include in his tender a list of the spare parts he proposes to provide.

3.13 Contractor's Responsibilities

The Contractor will be responsible for the installation and correct operation of all the Electrical Engineering Services in accordance with the details of this Specification, Associated Drawings and Client's Fit Out Specification. These documents should be read in conjunction with all relevant Architectural and Structural information.

3.14 Drawings, Specification and Schedules

Drawings of the works specified have been prepared by the Consulting Engineer as a basis for Tendering. It should be understood that they are diagrammatic and that it will be necessary for the Contractor to provide his own working drawings as indicated in the relevant section of this Specification. These working drawings shall be submitted to the Consulting Engineer, Client and Design Team for comment.

The drawings of the works specified are an integral part of this Specification and any work shown on these drawings but not detailed in the Specification and vice versa must be included in the Tender Figure.

The Drawings, Specification and Schedules shall be read together. The Contractor shall include in the Tender for any item or instructions detailed in the Specification and on Schedules attached hereto, whether or not the item or instruction concerned is detailed on the drawings.

The Consulting Engineer and Client reserve the right to effect alterations to the positions of lighting fittings, switches, outlets, diffusers, etc. as required by ceiling and partition layouts and site requirements. Such alterations shall be carried out without extra charge providing there is no additional material involved and the instructions are given before the work proceeds.

3.15 Equal and Approved

The use of alternatives will not be considered without the agreement of the Engineer.

Should it be deemed acceptable for the Contractor to propose alternatives then it will be necessary for the Engineer to be commissioned to analyse and comment on the proposal.

This commission will be quite separate to the original commission and the Consultant will endeavour to analyse and comment on the proposal in an objective manner.

To undertake any assessment the Contractor will provide the Engineer with detailed data to allow an assessment to be undertaken.

For example when alternative luminaires are proposed, the Consultant will request the submission of full photometric characteristics for all alternative luminaires being offered, including the necessary polar curves or equivalent as well as detailed lighting calculations. Such data and calculation should be reviewed to ensure that the alternative luminaires still meet or exceed the scheme parameters and criteria. Any calculations submitted must be made using the same parameters, such as room reflectances and maintenance factors, as the original calculations. Submissions of such calculations must be considered as a legal undertaking by the submitting party, and should be covered by suitable professional indemnity.

The energy consumption of the submitted luminaire must be checked against that of the specified luminaire. If the energy consumption is higher a re-calculation of the overall energy consumption of the luminaires in the building may be required to confirm that the installation still meets the requirements of Part L2 of the Building Regulations. In the case of external public lighting that is un-metered, the energy consumption of the luminaires should be checked to ensure that they comply with the requirements of BSCP250.

The Consultant must be satisfied that the luminaires being offered as alternatives are of equal quality, durability and robustness as the luminaires specified. This may require submission of sample luminaires for both specified and alternative luminaires and any components forming the total luminaire and its support. This is not to say that a luminaire with lesser construction and robustness properties will not be acceptable but does give a measure and yardstick against any declared 'benefits'.

Alternative luminaires must be considered both individually and in relation to other luminaires on the project to ensure aesthetic acceptability. This exercise should be carried out in conjunction with the Architects, Designers, Client and other interested parties who were involved in the selection of the original luminaires. In the case of exterior lighting this assessment should be carried out in conjunction with any fixing system, for instance in road lighting, the bracket and where applicable the lighting column. It is not equitable to subject any alternative luminaire to greater review than the original luminaire.

If the project circumstances had dictated special characteristics for the luminaire that are not covered by normal product or installation standards or directives then the assessment process should assess whether the proposed luminaire meets these special characteristics. Compatibility of components and systems should be checked to ensure safety and performance of the original design is maintained, e.g. any change from the specified control gear may adversely affect the projected lamp life.

Luminaires should only be specified that meet and comply with British Standards or European Standards. Any alternative luminaire should be submitted with full specification and technical detail sheets to show that they meet the same or equivalent standards. Where a proposed luminaire performance in any way differs from the specified luminaire a case should be submitted to support the alternative product and deal with the differences specifically.

The ease and simplicity of maintenance should be considered as part of any assessment of any alternative luminaires submitted. Any alternative luminaires should meet any specific maintenance factor for the installation.

Whatever the benefits, be they financial, ease of installation or time saving on the contract, they should be declared with the submission and request for change of the specified luminaire.

3.16 Co-ordination of Electrical and Mechanical Services

The Contractor is to ensure that all electrical services are fully co-ordinated with the Mechanical Contractor to ensure that there are no 'clashes' of services on site.

Both Electrical and Mechanical Contractors are to undergo a co-ordination process before the installation of services on site.

All Electrical Services including cable containment (tray/basket) both horizontally and vertically, socket outlets, floor-boxes, light fittings, smoke detectors are to be co-ordinated by the Contractor prior to installation to avoid 'clashes' on site.

3.17 Training of Employer's Staff

The Contractor shall allow within his tender price for training of employer' staff in the use of the following systems. The necessary training shall be provided and adopted for laymen at Practical Completion with an accompanying video recorded presentation:-

The following systems shall be included where applicable:-

1. Fire Alarm
2. Emergency Lighting
3. CCTV
4. External Lighting
5. Miscellaneous Services
6. Door Access
7. Security/Intruder
8. Warden Call/Nurse Call
9. Horizon Smart Metering
10. Maintenance Procedures
11. Panic Alarms/Staff Attack
12. Disabled Refuge and Alarms
13. Renewable Technologies
14. Standby Generator
15. UPS
16. Public Address
17. Hard of Hearing Induction Loop.

This training shall demonstrate the purpose, functionality and operation of each discipline listed above and within the Operation & Maintenance Manual(s).

The Contractor shall produce and administer a training acceptance and declaration form for the operator's signature post completion of the demonstration exercise.

3.18 Equipment to be Handed Over at Contract Completion

At Practical Completion, the Contractor shall present the Client's Agent with the following documentation and equipment:-

- a) Record documents as detailed in Section Two.
- b) Operating and Maintenance Manuals for all items of equipment supplied as detailed in Section Two.
- c) Electrical Test Certificates including NICEIC Inspection and completion Certificate in duplicate.
- d) All padlocks and keys for isolators on main LV switchgear.
- e) Keys for MCB distribution boards, isolators, etc.
- f) Manufacturer's Test Certificates for all equipment.
- g) Spare parts as listed within the Schedule of Spares.
- h) Record readings of all water, gas and electricity meters immediately on completion of the works.
- i) Residual Risk Assessment.
- j) Description of required maintenance for each system.
- k) Design Criteria Statement for all services to be 'Design Portioned' to the Contractor, e.g. lightning protection, lifts.
- l) Demolition Statement.
- m) Building Log Book

The Client's Agent will not accept handover until the above documents/items are in the Client's possession.

3.19 Maintenance

The Contractor shall include for the first years maintenance commencing from the date of Practical Completion for total maintenance for all electrical systems installed in accordance with the approved Operation and Maintenance Manuals.

This maintenance shall include all costs for visits by the specialist systems manufacturer's representative to check and maintain the systems in full working order.

These costs are entirely separate from the Contractors obligations in relation to the defects liabilities period detailed elsewhere.

The maintenance shall include, but not be limited to, the following services (where applicable):-

- Ring main unit, transformer, switchgear, LV distribution equipment and cabling
- UPS
- Standby generator
- TV systems
- Audio visual and public address systems

-
- Fire alarm and remote monitoring link
 - Lighting, emergency lighting and controls
 - Access control
 - CCTV
 - Intercoms
 - Security system
 - Lightning protection
 - Renewable technologies.

The Contractor shall include a detailed schedule of maintenance for all installed systems and services, indicating maintenance periods and a summary of the work involved.

4.0 FIRE STOPPING FOR SERVICES PENETRATIONS

4.01 General

The Contractor shall employ the services of a specialist fire penetration seal Contractor who is 3rd party certified by an approved organisation including but not limited to LPCB, BRE, FIRAS, IFC, BM TRADA, to design, specify, install, and certify a complete fire stopping system for all MEP services penetrations.

The specialist shall utilise only proprietary fire stopping and penetration seal products which are 3rd party certified by a UKAS accredited organisation. Firestopping products should be certified, CE marked and tested using the relevant standards.

Wherever practical, one firestopping and sealing system manufacturer shall be utilised throughout the project. In the event this is not possible, it is strictly forbidden to utilise products from different manufacturers within the same penetration opening unless there is clear unambiguous test evidence to verify performance and substantiate their use.

The firestopping details shall be developed in accordance with the requirements of the project specific Fire Strategy report, drawings and digital model and agreed and approved by the Fire Engineer and local Building Control/Fire Officer.

The Contractor shall be responsible for liaising closely with the specialist fire penetration seal Contractor to carefully coordinate the sequencing of installation works to ensure there is sufficient access to install and maintain the services penetration seals.

All firestopping products shall be installed strictly in accordance with the manufacturer's recommendations and guidance to ensure that they perform with their tested capabilities in the situation they are being used.

When sequencing the work, compartment walls with prepared openings should be programmed ahead of the installation of the M&E services to ensure the compartment wall can be installed compliantly above the services.

4.02 Design Standards and Guidance Documents

The penetration seal systems, their certification and installation shall conform to the following standards and guidance documents.

- Approved document Part B of the Building Regulations
- BS 9991 – Fire safety in the design, management, and use of residential buildings. Code of practice.
- BS 9999 - Fire safety in the design, management, and use of buildings. Code of Practice.
- Project specific fire strategy
- BS 1366 series – Fire resistance tests for services installations
- BS 476 series – Fire tests on building materials and structures
- BS EN 13501 series – Fire classification of construction products and building elements.
- Building Bulletin 100: Design for Fire Safety in Schools
- Department of Health Technical Memorandum 05-02: Fire code guidance in support of functional provisions for healthcare premises
- BESA DW/145 Guide to good practice for the installation of fire and smoke dampers

4.03 Spatial Coordination of Services and Fire Protection Seals

The Contractor shall be responsible for the final setting out of all services which shall be coordinated with the specialist sealing services Contractor to ensure sufficient spatial clearances for a compliant installation.

The specialist fire penetration seal Contractor shall design all fire protection seals in coordination with the MEP installation drawings, and the penetration seals shall be;

- Adequate to accommodate the required quantity and type of services passing through the fire separating element.
- Coordinated and certified for use within fire separating element and supporting construction for which it is to be installed.
- Installed only in supporting substrates which are covered by the third-party certification.
- Provide a fire resistance period of equal to or greater than the resistance period of the fire separating element.
- Provide fire resistance to fire penetration (Integrity (E)) and fire resistance to the transfer of excessive heat (insulation (I)) of equal to or greater than the integrity and insulation of the fire separating element.
- Comply with the relevant test standards BS EN 1366 or BS 476 as applicable.
- Complete with any additional properties which may apply to the penetration aside from fire protection, including but not limited to, acoustic performance, air tightness, air pressure, water resistance, smoke seal and even aesthetic requirements where in an exposed location.
- Tested and certified for the opening in which they are installed.
- Provided within framed openings within dry lining systems where required to meet the product testing and certification approvals.
- Coordinated with the supporting construction to ensure the penetration seal size is capable of being formed in the location required.
- Adequately spaced from other penetration seals in the same supporting construction
- Coordinated with any load bearing requirements, and installed according to the load it is designed to carry.
 - Note - Where fire stopping is installed in load bearing situations, they are normally only suitable for load bearing applications in a cold state and not during fire conditions. They are therefore not suitable for manned or storage areas.
- Tested and certified for the type of service passing through.
- Tested and certified for the size of each service passing through.
- Coordinated with any special requirements for movement of the supporting construction which may be lateral, rotational or shear, and tested and certified for the relevant application.
- Coordinated with the insulation type installed to building services, the reaction to fire properties of the insulation, and where this passes through the seal it is tested with the insulation in place as this is considered part of the fire seal.

The MEP services shall be spatially coordinated such that those passing through fire rated elements and constructions are;

- Adequately separated from other services to allow the seals to be installed in accordance with the manufacturers approved details
- Adequately separated from other services within a multi-service seal to allow the seals to be installed in accordance with the manufacturers approved details.
- Adequately positioned with distances between the penetration seal edge and services in accordance with the manufacturers approved details
- Adequately positioned to maintain minimum distances between penetration seals and supporting constructions.
- Adequately supported on either side of the penetration seal at a distance of no greater than the distance covered by the approved test certification.
- Readily accessible for future inspection, testing and maintenance requirements.

4.04 Technical Submittals

The Contractor shall provide technical submittals for all proposed fire protection sealing products, which shall include but not be limited to;

- Product datasheets and brochures
- Product test certificates and third party approvals
- Product CE mark and Declaration of Performance (DoP)
- Manufacturers installation instructions and approved installation details

The Contractor shall also provide working installation drawings, including for all fire penetration sealing requirements, from which a comprehensive set of builders work drawings shall be prepared by the Contractor.

All documents shall be submitted to the client, fire engineer, building control, architect, structural engineer, and consultant engineer for approval prior to commencement of works.

4.05 Site Quality Management

The Contractor shall employ the FIS “PPP” quality framework to record the fire sealing installation:

Product	Keep records of the specification, test evidence, purchase orders and delivery notes.
Process	Keep dated site images of the installation, particularly elements which get closed up prior to completion of the build.
People	Keep records of the skills, attitude, knowledge and experience of any person who installed the system.

The records from the process shall be recorded within the O&M manuals upon completion and be available for inspection at all times on site.

4.07 Benchmarking and Samples

The Contractor shall include for the preparation of sample wall and fire penetration sealing constructions as a benchmark for each type of wall type and fire sealing product combination, to provide an approved quality control benchmark for use across the project.

The benchmarks shall be signed off by all relevant parties including the client, fire engineer, building control and consultant engineer for approval prior to commencement of works.

4.08 Inspections and Photographic logs

The fire protection sealing installation shall undergo a thorough inspection regime to ensure all seals are installed compliantly, and as a minimum this should follow the guidance of ASFP Technical Guidance Note 17.

The penetration works must be inspected by someone within the same company, other than the installing operative, who has responsibility for checking and signing off the work including the placing of labels to demonstrate this.

An electronic system shall be employed for monitoring and managing the fire penetration sealing installation.

The Contractor shall complete a photographic evidence log, which shall be reference against each unique fire protection seal number, which shall be held on file to form part of the O&M manual at handover. Photographs should be taken before, during and after installation of the seal.

4.09 Labelling of Service Penetration Seals

Service penetration seals should be clearly labelled by the specialist contractor on completion with the following information:

- Unique reference number of the penetration and the seal
- Installation date
- Name of the operative who installed the seal
- Name of the supervisor who inspected the seal
- Name and contact details of the manufacturer
- Name and contact details of the specialist contractor
- Date of next inspection

4.10 Maintenance

The manufacturers maintenance requirements for all fire penetration seals shall be clearly detailed and included within the O&M's at handover.

4.11 Operation and Maintenance Manuals (O&M's)

The Contractor shall provide a digital O&M manual on completion of the works which shall include but not be limited to;

- Details of penetration seals installed within project including all accreditations and 3rd party certifications.
- Details of the specialist penetration seal Contractor
- Details of the penetration seal manufacturer(s)

- Full performance requirements of the penetration seals including integrity and insulation
- As built Plans and models showing the location and unique reference of all fire stopping seals, the finished size and construction details
- Photo log cross referenced with the plans/model using the unique ref number, logged with details of penetration seal
- Quality check records
- Future inspection and maintenance requirements

5.0 DEMOLITION AND ENABLING WORKS

5.01 Removal of Existing Lighting installation

The contractor shall disconnect and remove the existing high-level luminaires within the main arena.

Prior to removal the contractor shall agree with the on-site client team which luminaires are to be retained and safely stored for use by the centre as spares.

All remaining luminaires shall be disposed in accordance with the WEEE regulations. The contractor shall appoint a licensed contractor to dispose of the luminaires at a certified disposal waste disposal/recycling centre. The contractor shall provide a WEEE compliance certification

5.02 Floor Protection

The contractor shall provide floor protection to the complete sports hall and where required the contractors circulation routes to the space to ensure no damage results from the works. The protection shall be suitable for use of Heavy equipment and MEWP's without causing damage to the floor.

5.03 Mobile Elevating Working Platform (MEWP)

The contractor shall provide adequate availability of the MEWPS during the contract period to ensure the works are completed on time, no additional costs shall be acceptable to the client for the provision of additional access equipment to achieve the completion date.

5.04 Site Compound

The contractor shall provide welfare facilities during the site set-up and construction period.

The contractor shall provide adequate site storage facilities for all required materials during the construction period

The contractors shall provide all skips, recycling and refuse facilities to ensure a clean and managed site during the works period.

6.0 INCOMING SERVICES

6.01 Electricity

No works are required to the incoming Electrical services

7.0 CABLING & CONTAINMENT SYSTEMS

7.01 General

The installation shall generally be wired as follows:-

Item	Cable Type	Containment Method
1. Lighting & Small Power	LSF single core stranded copper cables (6491B)	Existing Galvanised steel trunking surface mounted to structure. Where indicated on layout drawings, New galvanised 50 x 50mm Lighting trunking.
2. DALI control Cabling	1 Pair Beldin 8719NH LSF Screened twisted pair cable or equivalent Cable to be rated at 450V or separate containment system to be installed to serve all luminaires comprising of 50mm cable basket	Installed within new segregated cable basket.
4. Emergency Lighting	Multi-core Fire rated cable to provide 120min fire resistance such as Prysmian FP Plus Cable to be have a white overall covering.	Installed within new segregated Cable basket.
5. Supplies to Emergency Lighting Distribution Board.	Multi-core Fire rated armoured cable to BS 7846 F120 LSOH sheathed as Prysmian FP600S	Installed on new perforated heavy duty cable tray.

7.02 General Requirements

All cables and wiring systems shall be supported with fire resistant fixings without exception, to prevent premature collapse during fire conditions. Plastic, nylon and aluminium fixings are not acceptable.

Where surface installations are unavoidable, cables shall be dressed flat, free from twists, kinks, strain and aligned parallel to building elements. Where glands and clamps are not required, the Contractor shall extend the cable sheath through to the associated accessory boxes and equipment. Potential cable abrasion shall be overcome through the use of grommets or similar sharp edge protection.

Where vertical conduit is installed, cable clamps shall be provided in conduit boxes at 10m intervals.

All cabling shall be installed in an orderly fashion, capable of being withdrawn without affecting the local construction finishes.

The Contractor shall allow for full range of movement at building construction movement joints. All joints to wiring shall be made at terminal blocks within conduit boxes.

The Contractor shall ensure that the capacity of all primary cable containment is sufficiently sized to accommodate all cabling proposed with a further 25% provision for future extension.

The contractor will be responsible for the design of the containment supports and fixings to suit the cable loadings and containment types.

It shall be the responsibility of the Contractor to protect all apertures through fire compartmentation lines. Fire prevention shall be achieved through approved techniques at positions coordinated with the containment installations and the building's Fire Strategy Layouts.

7.03 Cable Jointing

It is anticipated that the existing interconnecting cabling between luminaires will not be of sufficient length to match the positions of the new luminaires the contractor shall therefore install new interconnecting cabling to suit the new lighting configuration. No joints of the existing cables shall be accepted. All existing redundant cabling shall be removed from the containment system.

7.04 Existing Containment System

The existing high level containment system is to be reused to support new luminaires and cabling. The existing containment system requires minor repairs due to its age the contractor shall undertake these repairs as part of the works, the repairs shall generally include the following.

- Provision of replacement trunking lids
- Refixing of trunking lids, a number of lids are supported using plastic cable ties, these shall be removed and lids refixed using rivets or blunt self-tapping screws.
- Refixing or tightening of trunking supports.

7.05 New Containment Systems

New galvanised steel trunking Lighting trunking shall be installed at high levels as indicated on the associated layouts to support and services new luminaires orientated at 90° to the existing containment and lighting installation to provide optimum luminaire positions for competition badminton.

7.06 New Cable Basket Containment System

The contractor shall supply and install a new Cable basket system throughout the space to link all luminaires. The cable basket shall support the new DALI cabling and the new emergency lighting cabling to facilitate this the contractor shall utilise cable basket dividers to maintain segregation of the services.

The cable basket system shall be supported from the structure throughout.

7.07 DALI Cabling

The contractor shall supply, install and test a complete DALI 2 cabling solution to provide control of all luminaires. The contractor shall install DALI cabling as per the type indicated in section 7.01 to each luminaire in accordance with the control specialists requirements.

7.08 Sub Main Cabling & Containment

The contractor shall install new sub-main cabling from the existing distribution board DB-34 within the first floor PA room to a new Emergency Lighting distribution board and new emergency lighting central battery system located in the first floor PA room as indicated on the associated schematic drawing.

All new cables serving or emanating from the new central battery emergency lighting installation shall be fire rated and provide 120min protection against fire to BS 7846

Sub main cables shall be supported on cable tray. The support system shall be designed with durability and strength as paramount requirements. All cable tray supports shall be galvanised and installed at centres such as to prevent deflection in the tray and where necessary, galvanised mild steel angle supports shall be installed along the length of the tray.

Multiple cable runs shall be supported on cable tray of adequate strength for the number and size of cables concerned, plus minimum of 25% spare capacity. Cable tray shall be affixed to the building fabric within designated service voids, risers or zones. Cabling shall be dressed in such a manner that crossovers are eliminated.

All sub-main cabling shall be laid side by side, individually fixed using cleats or cable ties. Metallic cable clips shall be used on all fire performance rated cables.

7.09 Sub-Circuit Cabling & Containment

The contractor shall undertake a full inspection and test of the existing circuits supplying the existing lighting and identify any areas of improvement required prior to installation any new luminaires or cabling. These shall be reported to the contract administrator for review and approval of the remedial works required.

The installation of general LSF lighting and power cabling shall be via existing galvanised, trunking installed at high level with new secondary conduits to final outlets positions where required.

The Contractor may consider the use of multi-compartment trunking for the installation of ELV systems wiring and/or fire alarm system wiring. Where multicompartment trunking is proposed, proprietary divider plates shall be installed to segregate the respective LV and ELV cabling accordingly.

Sub-circuit cabling containment shall be supported along its entire length with all sections of the basket/trunking and associated fittings efficiently and adequately bonded as required in Section 8. Fixings shall be adequate to carry the containment (at full load) without deflection, with due consideration for appearance, access and rigidity.

Where brackets are required to support cable containment, they shall be constructed in steel using flat angle or channel sections such as to ensure strength and rigidity for the particular duty. Where brackets are fixed to the building or structure or steelwork, these shall be affected by the use of patent type of special fittings as appropriate, but permission obtained from the Contract Administrator before any such work is carried out. All fixing brackets shall be given two coats of red oxide paint after erection.

All cable containment shall be securely fixed to brackets by means of plated, round head bolts, nuts and lock washers with bolt heads to avoid damage to cables.

Where cable containment passes through structural apertures, a cover plate shall be fixed to the containment before installation. This shall be arranged to project at least 50mm beyond the finished surface of the wall or floor. Fireproof barriers shall be fitted at these positions.

Cable Trunking Requirements

Steel conduit connections to cable trunking shall be undertaken by means of smooth bore brass bushes and couplings. The trunking shall be cleared of all paint at the point of contact and repainted immediately upon completion of the conduit installation.

Where vertical runs of trunking exceed 5m in length, the cables shall be supported in an approved manner and internal barriers fitted every 3m to prevent excessive rise in air temperature at top of trunking.

All removable covers, which shall be of the screw fixing type, shall be securely fixed after completion of the works.

Regardless of the trunking size, the containment shall be attached to the building framework or fabric at intervals of not more than that recommended by the manufacturer.

Any proprietary joints in the trunking shall be arranged to not overhang fixing points by more than 700mm.

All trunking fittings (i.e. bends, tees etc.) shall leave the main trough completely clear of obstruction and the cover shall be completely accessible except through walls and floors at which points suitable fire resisting barriers shall be provided. All fittings shall be compatible with the main body of the trunking.

All trunking shall be electrically continuous by means of 30mm x 5mm copper links across each joint in the system. Connection shall be made by means of electro-tinned bolts (heat inside trough), nuts (6mm diameter minimum), flat washers and spring washers and where trunking is galvanised, the galvanising shall be removed within 6mm of the joint strap and painted after to prevent rusting.

8.0 LOW VOLTAGE DISTRIBUTION

8.01 General

As part of the works the contractor shall supply and install a new MCB distribution board within the first floor PA room to serve the emergency lighting installation.

The existing DB-34 serving the existing lighting is a Merlin Gerin unit. The contractor shall replace the existing MCB's serving the current installation with new units of current rating and type as indicated on the associated drawing.

8.02 Distribution Boards

All main and sub-main low voltage distribution equipment shall be procured and installed by Contractor generally as indicated on the Main Distribution Schematic and associated schedules.

All distribution boards shall be provided with lockable, hinged covers and relevant circuit protection for outgoing ways as detailed in the Electrical Schedules.

All main and sub main distribution boards shall be fitted with engraved warning and identification labels stating the reference of the board, phasing details and its supply orientation.

All panel/distribution boards shall be provided with a typewritten circuit list which shall be attached to the inside of the hinged lid in a heavy duty, transparent plastic envelope. The circuit list shall include the following information:-

- DB Reference
- Supply Point
- Circuit Numbers and Phases
- Circuit Designation
- MCB Rating
- RCBO Rating
- Cable Type and Size.

All distribution boards shall be of the same manufacture throughout.

General Performances

All MCB distribution boards shall comply with the relevant parts of BS EN 61439 and phase identification to BS 7671.

All MCB distribution boards shall be fabricated from rust protected sheet steel and be coated with epoxy powder paint, the finished colour to be RAL 9001.

All MCB distribution boards shall include a fully shrouded main busbar assembly which shall include integral provision for the electrical connection and isolation of an unused outgoing ways and the live side terminals of outgoing MCB ways. Where boots or similar devices are supplied to cover live parts of spare ways the board will be deemed not to comply with this requirement.

All MCB distribution boards will be supplied with a manufacturer's 5 year guarantee.

All MCB distribution board neutral bars shall be supplied complete with insulating cover requiring the use of a tool to facilitate its removal on B type boards.

All MCB distribution boards outgoing ways shall be capable of conversion, through the use of a kit, to facilitate neutral switching through the use of 2 or 4 pole devices.

All MCB distribution boards shall accept 1, 2, 3 and 4 pole (3 or 4 pole on B type boards) MCB's as outgoing units, be capable of accepting the following outgoers.

- a) Combined MCB/RCD's (RCBO's) of single phase type having the following characteristics:-
- Manufactured and tested to BS EN 61009
 - A breaking capacity of 10kA to BS EN 60898
 - A or AC classification
 - 10, 30 or 100mA sensitivities
 - Permanent non-adjustable and non-removable earth fault protection
 - A width of no more than one outgoing way where the neutral is unswitched
 - Automatic protection against reverse polarity
 - Automatic disconnection in the event of a lost neutral
 - Be able to accept auxiliary contacts, under voltage release or shunt trip.
- b) Combined MCB/RCD's (RCBO's) of three phase type providing protection, disconnection and isolation of all live conductors including the neutral.
- c) MCB's combined with a full range of electrical auxiliary devices:-
- Shunt trips
 - Undervoltage releases
 - Auxiliary switches
 - Alarm switches
 - Emergency stop release.
- d) Any combination of a), b) and c) above.

General Installation

All MCB distribution boards shall be suitable for surface mounting

All MCB distribution boards shall make ample provision for cabling. In particular cable space must be available to the rear of the pan assembly, furthermore the pan assembly shall be removable to further ease cabling and to avoid the ingress of foreign bodies during the preparation of cable entry points. The Contractor shall ensure that all outgoing phase cables are afforded circuit identification tags.

All MCB distribution boards shall be supplied from the distributor without the incoming device fitted. Incoming device including terminal blocks, switch disconnectors, MCCB's and RCD's shall be available separately such that the maximum flexibility is maintained.

All MCB distribution boards shall facilitate the protection, connection and isolation of all incoming and outgoing live conductors including the neutral, such that routine tests can be performed with the minimum of effort.

Type 'B' MCB distribution boards may be required to be associated into neat and tidy groups as specified in the schedules. Units shall therefore be of modular dimensions, and it should be possible to mechanically join boards both vertically and horizontally with the use of a manufacturer supplied kit.

Single phase 'A' type MCB distribution boards shall be also available in modular dimensions for similar association.

Range of Manufacture

To allow for all installation requirements to be met using the same manufacturer's equipment, the manufacturer shall provide a complete service as follows:-

- Provide a complete range of 'A' type and 'B' type distribution boards and accessories,
- Provide a complete range of 'A' type and 'B' type multi-service units enabling the inclusion of both MCB's and control devices such as contactors, push buttons, signal lamps, etc. in the same enclosure grouping,
- Provide a complete range of metal-clad and all-insulated individual enclosures,
- Provide a complete range 10kA to BS EN 60898 (15kA to BS EN 60947-2) MCB's with current rating up to 63A,
- All MCB's shall be panel mounted with or without DIN-rail by preference, this requirement shall be met as standard however an accessory is an acceptable solution,
- Be capable of providing 'specials' by manufacturing prefabricated assemblies in their own workshop.

8.03 Miniature and Moulded Case Circuit Breakers

Miniature and moulded case circuit breakers shall comply with BS EN 60898 and BS EN 60947-2 respectively and shall be installed with due regard to the environmental conditions prevalent on site. All breakers shall be selected in accordance with the British Standards with due regard to operating characteristics, current rating, calibration and discrimination. Adequate backup protection by mccb's shall be provided. Miniature circuit breakers shall be unconditionally rated at a category of duty M9 or higher. The effect of ambient temperatures, operating duty, and application, shall be fully considered in applying derating factors for application at site.

Multi-phase miniature and moulded case circuit breakers shall have means for preventing any one pole of a multi pole circuit breaker being operated or tripping independently of the other poles.

Miniature and moulded case circuit breakers shall have locking facilities and be supplied with all keys, or shall be enclosed in cases with locking facilities which shall be provided with keys.

Miniature and moulded case circuit breakers shall be of the same type throughout the Contract.

All MCCB's and MCB's shall be mounted on a removable din rail. The neutral bars shall be drilled for at least one connection per circuit way.

MCCB and MCB banks in cubicle panels shall be of a similar pattern to those enclosed in distribution boards.

All MCCB's and MCB's used in Distribution Boards shall have a minimum fault rating of not less than 14,000 amps breaking capacity.

9.0 EARTHING

9.01 General

The Contractor shall supply and install a new earthing system to the replacement lighting installation in accordance with the requirements of BS: 7671 this shall include but not be limited to the following

- New CPC conductors for sub-circuits.
- New CPC conductors for sub-main circuits.
- New supplementary bonding of existing and new containment system.

9.02 System Description

Provide a supply system earthing network as outlined below:-

The Contractor shall connect equipotential bonding conductors to the main earthing terminal as listed in Section 9.05 below.

All sections of metal cable trunking, shall be suitably bonded together with suitable copper strip, secured by brass machine screws with heavy brass washers, nuts and locknuts. The copper bonding strip shall have a cross sectional areas as required by Regulation, but in no case shall it be less than 25mm x 2.5mm in section.

An earthing terminal shall be provided on each piece of equipment necessary or apparatus supplied to the Contractor. The terminal shall consist of a substantial brass set screw, brass nut and washer.

All earthing conductors shall (unless otherwise stated) shall be enclosed in galvanised steel conduit or trunking.

Care shall be taken to ensure that all joints are properly made and bonded to ensure continuity. The earth system shall be connected to the earth bar.

At completion, the Contractor shall provide internal fire stopping of all cable trunkings as they pass through fire compartment walls/floors, in compliance with Regulations 527.2.

Protective conductors shall be installed in all flexible connections. The metalwork of all lighting fittings and other current using equipment shall be earthed.

All local lighting and small power circuits shall be provided with a separate CPC.

Provide earthing systems for standby/firefighting generators in accordance with this specification and drawings.

10.0 LIGHTING INSTALLATION

10.01 General

The contractor shall supply and install a new lighting installation to replace the existing lighting installation within the sport hall / arena to provide a flexible and functional space capable of hosting multiple indoor sports at a variety of sporting levels from practice to international events as but not limited to;

- Badminton
- Table Tennis
- Netball
- Boxing
- Wheelchair Rugby
- Gymnastics

The lighting installation shall comply with the following standards including requirements set out in section 2.02.01;

- CIBSE Lighting Guide 4
- Badminton World federation – Statutes , Section 5.3.4

To provide the functional lighting installation a new DALI addressable control system that is pre-programmed to provide various lighting levels and configurations.

The lighting installation has been designed using Whitecroft Lighting Luminaires to provide a general overall lighting level at the floor of 1000lux at 0.4 overall uniformity and a minimum of 0.7 uniformity at each badminton court.

The Contractor shall ensure that the installation and location of all luminaires is provided as depicted on the lighting and emergency lighting drawings. Luminaires shall be erected in exact locations to ensure the task, immediate and background illumination levels set out above are achieved.

10.02 Luminaires

The luminaires shall be as indicated on the associated layout drawings and consist of consisting of new trunking mounted IP40 IK10 4000K DALI controlled dimmable Sports luminaires.

No conductors less than 1.5mm² size shall be used for the installations hard wiring and all conduit systems steel or PVC must carry an earth continuity conductor of suitable capacity. This requirement also applies to flexible conduit connections and cable trunking systems.

Due to the use of the space the contractor shall appoint a specialist to design and supply a dedicated independent secondary supports to all luminaries to ensure that a failure of the main containment system fixing will not result in a catastrophic failure and dangerous occurrence. The secondary supports shall be capable of carrying a mass of double the weight of the luminaire and be designed to take into account dynamic forces such as thermal expansion, vibration and the effects of a fire.

10.03 Warranty

The Contractor shall ensure all luminaires and their control devices are under warranty for a minimum of 5 Years from the date of handover.

Where a failure occurs within the first 24months from practical completion the contractor / lighting manufacture shall undertake all required on-site works to rectify and repair the fault.

Where a fault occurs from 24months to 5years from handover the manufacturer shall provide free issue all required parts or materials to repair the luminaires.

Where luminaires have been installed prior to handover they shall remain the responsibility of the Contractor thus the warranty period not commencing until the handover date.

11.0 Lighting Controls

11.01 Controls Philosophy

The lighting system shall be provided with a programmable flexible WEB application based DALI-2 control system that is easily configurable to meet a variety of user needs.

The system shall provide a variety of preset lighting scenes and facility to manual control individual luminaires, groups or rows of luminaires providing on/off and 1 – 100% dimming.

The system has been based upon Helvar Controls

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11.02 System Design

The contractor shall appoint as specialist supplier to design, supply, configure and commission a complete Lighting control system.

The specialist shall ensure that the system is fully commissioned and tested prior to the completion date of the **17-12-2026 – 17:00. It is therefore expected that the specialist shall complete the commissioning and testing prior to this date to allow the contract administrator and client to view the operation of the control system and be trained on the basic functions of the system.**

The system shall be capable of controlling the full functional DALI output of all individual luminaires.

The control system shall enable easy customization by the end user to enable new lighting scenes to be generated without the need to arrange an engineer visit.

The system shall provide the client with full autonomy and control of the system via a WEB based User interface. The interface shall allow the end user to undertake the following to the installation:

- Central control of individual luminaires.
- Creation of control groups.
- Creation of Lighting Scenes
- Operation of luminaires via a floor plan.
- Production of reports including, usage, energy consumption, faults

The system shall also be provided with 2 No fixed 7" touchscreens for control of the area from the main reception and 1st floor PA room. The touchscreens shall be linked to the central control software so that amendments made to the scenes or creation of new scenes are updated on the touch screens automatically.

The specialist shall supply and install all required DALI gateways, Nodes and application controllers to provide a fully functional system.

The contractor shall provide all required power supplies for the lighting control system.

The initial set up shall provide the scene configurations as indicated on drawing;

- 10110-MCP-V1-01-D-E-1004

The percentage outputs are indicative only and the contractor shall measure the lighting level for each scene to ensure the output of the luminaires provides the lux level as indicated.

The specialist shall allow for 2 half days training on the configuration of the system following the completion date to instruct the facilities management team on the following;

- General Use.
- Scene amendments.
- New Scene setup.
- Reports
- Fault notifications and rectification.

11.03 Digital Services Requirements

A modular suite of digital services shall provide interaction with and information from the lighting control system to the building owner, facilities managers and occupants to enable ongoing development of the building's operations over its lifetime to improve sustainability and the occupant's comfort.

The digital services shall be hosted by a cloud-based infrastructure, with the connectivity being provided by a gateway. The client interface shall be by means of a secure web-browser and optionally provide a means of access via a Virtual Private Network (VPN) for remote assistance.

The suite shall consist of a base module, providing control, monitoring and reporting functionality for the lighting control system or solution, with additional, optional modules available for specific building or user needs. Improved or additional functionality shall be implemented via the use of over the air (OTA) updates.

The digital services shall allow integration by 3rd party systems by use of a REST API.

11.03.01 Connectivity (Data, Security and Privacy)

Cloud connectivity where used shall be provided by a gateway(s). The role of the gateway shall be to securely transfer the data collected by the lighting control system to the cloud platform to be stored and processed.

Gateways shall be preconfigured so that they can only access, collect, store and send data for the site it is purposely destined to. Only authenticated entities and persons shall be eligible to access said sites data and services.

The cloud platform service provider and equipment manufacturer shall not claim any ownership over the data collected. The cloud platform servers used shall by default be in the EU.

The protocol that shall be used between the gateway and the cloud platform shall be Message Queuing Telemetry Transport (MQTT) secured and encrypted by Transport Layer Security (TLS) 1.2 or 1.3 at the transport layer.

The cipher suite used for TLS is ECDHE-ECDSA-AES128-GCM-SHA256. Authentication between the gateway and cloud platform shall use Amazon Web Services (AWS) signature version 4, to ensure data integrity for the cloud-based infrastructure.

The gateway shall also use standard Ethernet for communication to the lighting control system.

Client connectivity to the cloud platform, shall be by means of a web-browser secured using multi-factor authentication.

The protocol that shall be used between the client interface and cloud platform shall be Hypertext Transfer Protocol Secure (HTTPS).

The cloud platform service provider and equipment manufacturer shall not collect, store or use data that would directly or indirectly permit infringement of an individual's privacy or identification of any individual in a building or space. All data shall be collected anonymously. The data processing and use thereof shall strictly follow the General Data Protection Regulation (GDPR).

11.03.02 Virtual Private Network (VPN)

The system shall be capable of providing an optional VPN Tunnelling solution for remote access and assistance. To ensure the highest security and data privacy, the solution shall be third party tested and audited in accordance with the ISAE3000 Assurance Standard.

Two-factor authentication for access shall be required such as a physical or software key and a secure password. Only industry standard and proven technologies such as the Rivest Shamir Adleman (RSA) cryptosystem, Advanced Encryption Standard (AES) encryption, Diffie–Hellman key exchange and TLS sessions shall be utilised.

11.03.03 Base Module

The base module shall provide selectable views, as appropriate in the form of a floorplan showing the position of the lighting control system's devices and luminaires or table, views shall include Monitoring, Lighting Status, Emergency Lighting Status, Occupancy Heat Map and Reports.

In all views, basic information on a device shall be provided when hovering over the device. Selection of the devices shall give more detail to the user, such as alert history.

A web-based positioning tool accessible only to configuration and commissioning teams shall be available to position the lighting control systems devices on the floorplan.

The Monitoring view shall show the status of all devices, such as luminaires or sensors. The icons shall be shown in a way that it is clear if a device has an active alert.

Alert types shall be classed as critical, high, medium or low, with these designations referring to such things as device missing. Users shall have the option to subscribe to one or more of the alert types to receive notification by email.

Hovering over the device icons shall show the device description and active alerts. Selecting a device icon shall show on a sidebar the device's alert history, that allows the possibility to filter based on date, device name or address, status and severity within the alerts reporting table.

The Lighting Status view shall show the status of the luminaires. The icons shall be shown in a way that it is clear if a luminaire is on, off or dimmed with the transparency of the luminaire icon lightening as the light output decreases.

Hovering over the luminaire icon shall show the device description and the output level as a percentage.

Selecting a luminaire icon shall highlight all the luminaires in the same group and show the total number of luminaires in the group on a sidebar, it shall also show the time at which the light output changed to the current level. If the luminaire is part of multiple groups, all groups shall be shown.

The Lighting status view shall also provide a control icon, selection of which shall open a side bar enabling the user to then select any lighting group. Once selected, the group may be switched on, off or allow a scene to be changed.

It shall also be possible to add or modify a scheduled event for the automated changing of the scene. The scheduling feature shall be easily configurable and allow the option to repeat the scene change on a daily, weekly, monthly or yearly interval.

The Emergency Lighting Status view shall show the status of any DALI DT1 self-contained emergency devices or luminaires. The icons shall be shown in a way that it is clear if a luminaire is on or off.

Hovering over the emergency luminaire icon shall show the device description and the alert status. Selecting emergency luminaire icons shall show on a sidebar the devices emergency test history, as well as providing the option to start immediately either an emergency luminaire function or duration test for the device.

There shall be, in addition a history tab, that shall provide access to all emergency test results and reports. Test reports shall be stored in the cloud and retrievable in PDF format. The history tab shall also enable the user to automate the group testing of the emergency luminaire function or duration tests by use of a schedule. Immediate group testing may also be started from this tab.

An occupancy heat map shall show all the movement detection sensors on a floorplan and show the level of occupancy detected by each sensor in the form of a shaded area.

An animated visualisation shall show the occupancy on an hour-by-hour basis for a 24-hour period. The 24-hour period to be animated shall be selectable from a calendar on the heatmap.

Hovering over the sensor icon shall show the device description and the occupancy as a percentage. Selecting a sensor icon shall show on a sidebar, the occupancy duration as a percentage for the selected period.

The period the luminaires in a group remain on after the last movement is detected in the space shall be adjustable by use of the settings button, shown in the occupancy heat map view. 6. The Reports view shall allow the selection of the alert's history or event log. The alert history shall provide the details of active and resolved system alerts. The event log shall provide details of control actions that have occurred.

Both views shall allow filtering of the presented data, as well as allowing the data to be exported as a .CSV file.

11.03.04 Energy Monitoring Module

The energy monitoring module shall collect and present energy data such as the consumption (kW hrs) as used by the lighting control system.

Calculated energy data of the lighting systems devices shall be possible for both wired and wireless elements.

In addition, if the wired element uses DALI-2 drivers compliant with part 252 of the DALI standard, then the energy data shall be as read from the drivers.

The energy data shall be presented in a graphical view that shows the total building energy usage and offers the choice of a yearly, monthly or daily view.

A filter shall allow further analysis, by displaying energy usage for each floor, space types such as a corridor or lobby and the individual space.

All energy data shown in the graphs should be downloadable to a CSV file.

The energy data shall also be available in the form of a dashboard showing the total energy use for the year, month and current day's energy, with a comparison to the previous year, month and day.

12.0 Emergency lighting

Scope of Works

The Contractor shall Supply, installation, testing, commissioning, documentation, and handover of a central battery emergency lighting system serving all designated emergency escape routes, open areas (anti-panic), high-risk task areas, and emergency exit signage within the building.

Applicable Standards and Regulations

The system shall comply with the latest editions of:

- BS 5266-1 – Emergency lighting: Code of practice
- BS EN 1838 – Lighting applications – Emergency lighting
- BS EN 50171 – Central power supply systems
- BS EN 60598-2-22 – Luminaires for emergency lighting
- BS EN 62034 – Automatic test systems
- BS 7671 – IET Wiring Regulations
- Building Regulations (Approved Document B)
- Equality Act 2010 (visibility and accessibility considerations)

System Description

The emergency lighting system shall comprise:

- A 1000 VA central battery inverter system, rated for continuous operation
- Integral charger, static inverter, and battery assembly
- 230 V AC. maintained emergency supply output
- Individual or grouped automatic changeover relays to each emergency lighting circuit
- Standard 230 V LED emergency luminaires (no integral batteries)
- Normal lighting circuits shall energise the luminaires under healthy mains conditions. Upon mains failure, the changeover relays shall automatically transfer the luminaires to the central battery inverter supply.

Inverter Requirements

- Inverter Rating Nominal rating: 1000 VA minimum
- Output voltage: 230 V a.c. $\pm 10\%$
- Output frequency: 50 Hz $\pm 1\%$
- Power factor loading to be ≥ 0.99 unless otherwise stated
- The inverter shall be capable of supplying the full connected emergency lighting load plus losses at the end of battery design life.

Duration

- Emergency autonomy: 3 hours minimum
- Based on full connected load and worst-case battery conditions

Central Battery Unit

The unit shall be Comprise of a Steel enclosure, and either floor or wall mounted with a Powder-coated finish, with a IP20 rating.

The Static inverter shall be continuously rated and provide

- Overcharge and deep-discharge protection
- Automatic re-start after battery discharge

The central battery system shall provide visual indication of:

- Mains healthy
- Inverter running
- Battery healthy / battery fault
- Charger fault
- Inverter fault

Batteries

- Battery type: VRLA AGM Sealed Lead Acid Maintenance Free Batteries
- Designed to support full load for 3 hours at end of design life
- Battery design life ≥ 10 years (at 20°C for VRLA)
- Batteries housed within the central unit or in a dedicated adjacent enclosure
- Batteries replaceable without disruption to normal lighting circuits

Changeover Relays

Each emergency lighting circuit shall be supplied through a dedicated automatic changeover relay (ACO) Relays shall be fail-safe and normally energised under healthy mains conditions. The relays shall be housed within a 2hr enclosure adjacent to the inverter in the PA room

Operation

Normal condition: Luminaires fed from the local normal lighting circuit via the relay

Mains failure: Relay de-energises and transfers the circuit to the 230 V inverter output

Transfer time: ≤ 0.5 seconds

The module shall be provided with a dimming inhibit relay to reset all dimming control to 100%

The relays shall be accessible and replaceable without disruption to normal lighting circuits

Distribution & Wiring

Emergency lighting wiring shall remain at 230 V a.c. throughout and be supplied via Fire-resistant cables to BS 7629-1 with Enhanced fire resistance to provide fire resistance to 120min. All cables shall be provided with a White Sheath

All Emergency circuits shall be clearly identified and labelled:
"CENTRAL BATTERY EMERGENCY LIGHTING – DO NOT ISOLATE"

Inverter output circuits shall be segregated from normal lighting circuits except at changeover relays and supported via new cable basket containment system.

Testing & Commissioning

The testing of the emergency lighting installation shall integrate with the new control system to allow testing, monitoring and reporting to be undertaken through the use of the single system.

Verification of correct changeover relay operation on:

- Local circuit failure
- Incoming mains failure

Functional testing of all luminaires

- Full 3-hour duration test
- Confirmation of inverter load does not exceed 1000 VA
- Results recorded in emergency lighting logbook

The systems shall be provide with a manual test switch to allow the client to safely isolate the normal supply to individual circuits to ensure the operation of the system in accordance with BS-5266-1

Documentation & Handover

The contractor shall provide the following on handover:

- O&M manuals
- Inverter and battery data sheets
- Battery autonomy and load calculations
- Single-line diagram showing:
 - Central battery system
 - Changeover relays
 - Emergency circuits
 - Test certificates and commissioning records

The contractor shall provide Training for client maintenance staff on the operation and testing procedure of the central battery system.

Maintenance

The contractor shall provide 12months maintenance of the system to comply with BS 5266. The maintenance regime shall include the following.

- 12 Monthly functional tests
- 1 Annual full duration test to be undertaken out of hours or at a time mutually agreed with the client to ensure the system is fully re-charged following discharge.

The system shall provide automatic emergency illumination on loss of normal mains supply and comply

13.0 TESTING AND INSPECTION

13.01 General Requirements

The contractor shall undertake a full inspection and test of all new and existing lighting circuits in accordance with BS:7671 of DB-34 and provide a full NICEIC EICR detailing the full results for inclusion within the operation and maintenance manual.

14.0 RECORD INFORMATION

14.01 Record Drawings

The contractor shall provide record drawings of the completed lighting installation to reflect the actual on-site layout and distribution strategy.

The contractor shall provide a copy of the drawing for review by the engineer and on receipt of any comments amend the drawing accordingly and provide a full-sized framed version for mounting within the PA Room.

14.02 Labelling

The contractor shall update the labelling on all existing Distribution boards to indicate the following.

- DB Reference
- Supply Point

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