Property – Yorkshire Dales National Park Authority

Dales Countryside Museum

Station Yard

Burtersett Road

Hawes

DL8 3NT

Electrical Engineering Performance Specification

Date July 2025

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Site Yorkshire Dales National Park Authority, Dales Countryside Museum

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Align Property Partners
White Rose House (2nd Floor),
Northallerton Business Park,
Thurston Road,
Northallerton,
North Yorkshire
DL6 2NA
United Kingdom
T +44 (0)1609 797373

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Contents

SECTION 1: Electrical Services: General

1.01 Introduction

This specification is intended to indicate the minimum standard of design development, installation, workmanship, materials and performance required for the electrical services installation associated with the proposed works.

The work described in this specification is to be carried out in accordance with the Main Contract, preliminaries, specifications, associated drawings and schedules. The work includes for the supply, delivery to site, off-loading, installation, setting to work, testing, commissioning (including seasonal commissioning) and full defects liability period of twelve months from the date of satisfactory handover of the completed installations.

Where reference throughout this documentation is made to the Main Contractor, Electrical Contractor, Mechanical Contractor, Sub-Contractor, System Specialist or Equipment Manufacturer or Supplier, it is the responsibility of the Contractor to ensure that all parties liaise together during the Tender period to define the individual roles and responsibilities to each other.

The Contractor shall ensure that all liaison is undertaken during the Tender period and that all installation elements are included in the completed Tender.

For the Electrical Services installation, all System Specialists and Equipment Manufacturers or Suppliers appointed under the Services Contract shall provide all information and documentation required by the Contract relevant to the items of their supply to the Contractor.

The Contractor shall be responsible for ensuring that the supply of all required information and documentation is procured from the System Specialists and Suppliers as part of the Services Contract and shall be responsible for collating and indexing the information and documentation together with the remainder of the services information and documentation for the Main Contractor.

The Contractor shall be responsible for ensuring that the supply of information and documentation is procured from the Sub-Contractors as part of the Contract and shall be responsible for collating and indexing the information and documentation together with the remainder of the Contract information and documentation for the Employer.

The information relating to the Sub-Contract services shall include, but not be limited to, a quantified schedule of rates, quantities, cost, programme, Health and Safety, CDM, Environmental, COSHH, Operation and Maintenance, and Building Log Book information.

The work described in this specification shall be carried out in accordance with good working practice and shall comprise the development and co-ordination of the design, furnishing of fully co-ordinated working and installation drawings, and all labour, equipment and materials necessary to provide a complete installation.

The whole installation shall be completed and handed back to the employer in accordance with this Specification, General Conditions of Contract and Preliminaries as detailed in the Main Contract Specification, any Sub-Contract Specifications, Bill of Quantities and drawings.

The Contractor together with any system specialists employed on site shall be accredited to the Safety Scheme in Procurement (SSIP) and all system specialists shall be registered and accredited by an appropriate recognised organisation to demonstrate national independent recognition of ability and competence relevant to the specialist service provided.

The Contractor shall be -

- Registered and listed on the current NICEIC roll of approved contractors and/or ECA registered, certified and approved for all electrical services installation works.

The specification and drawings shall be read together and, where quantities or schedules are included in the specifications, on the drawings, or included within the Conditions of Contract and Preliminaries and/or the Bill of Quantities, the Contractor shall cross check all information provided.

Any discrepancies within the drawings, specifications or Contract documents, or between the drawings and specifications and Contract documents, shall be brought to the attention of the Contract Administrator during the Tender period. Any items indicated on the drawings but omitted from the specifications, or vice versa, shall be included by the Contractor.

All items of plant and equipment associated with the electrical services installations shall be installed, connected and commissioned in accordance with the manufacturers' written instructions and recommendations.

All works included in this specification and shown on the associated drawings, including all system specialist works included in the Services Contract, shall be undertaken and controlled by the Services Contractor under direction of the Contractor.

All work shall be fully co-ordinated and integrated with the proposed building structure, finishes, mechanical and electrical installation and other services, both to and within the building to the requirements of the Engineer.

The method of installation adopted by the Contractor shall ensure the health, safety and welfare of the public are not compromised.

The works shall be implemented in such a manner that results in the minimum of disruption to the surrounding buildings and their occupants, with particular regards to vibration, noise, dirt and dust.

This specification shall be read in conjunction with the Main Contract documentation and Mechanical Specification, together with all drawings and documentation contained within, referred to, or included with, this specification and its appendices.

1.02 General Extent of Works

The Contractor and associated System Specialists shall include for all necessary works, comprising the development of the design, supply, delivery, off-loading, positioning, installation, testing, commissioning, seasonal commissioning and client training to provide complete installations as described in section 3 of this specification.

1.03 Regulations and Standards

The whole of the electrical engineering services design development and installation including testing and commissioning shall be carried out by a NICEIC/ECA registered and approved Electrical Services Contractor who shall comply in all respects with the latest editions of the following regulations where applicable, together with all revisions and amendments current at the date of costings.

- BS 7671 Requirements for Electrical Installations IET Wiring Regulations.
- Regulations of the Local Regional Electricity Supply Company.
- Regulations of the Local Regional Communications Utility Supply Companies.
- Electrical Installation Standard Specification.
- The rules regulations and requirements of the JIB for the Electrical Contracting Industry.
- British Standards Specifications.
- Relevant Codes of Practice.
- European Standards where appropriate.
- Health and Safety at Work Act.
- Workplace Health Safety and Welfare Regulations.
- Electrical Equipment (Safety) Regulation.

- Electricity at Work Regulations.
- CIBSE, BSRIA, HVCA Guides and other publications.
- Gas Safety (Installation and Use) Regulations.
- Planning Legislation.
- Building Regulations including the requirements of the local Fire Authority, Building Control Officer and Environmental Health Officer.
- BREEAM Environmental Standards.
- The requirements of the Equality Act.
- The Construction (Design and Management) Regulations.
- The Control of Substances Hazardous to Health Regulations.
- The Personal Protective Equipment at Work Regulations.
- Environmental Protection Act.
- Environmental Protection (Duty of Care) Regulations.
- The Waste Management Licensing Regulations.
- Water Resources Act.
- Water Act.
- Control of Pollution.
- WEEE Regulations.
- All other relevant statutory regulations.

Wherever there is a British Standard or BS EN applicable to the manufacture or installation of plant, equipment and materials specified, then that standard shall apply.

All operations shall be carried out by fully qualified and trained competent electrical tradesmen, and any Specialist Sub-Contractors employed by the Contractor shall be members of, and accredited by, recognised national or international trade organisations relevant to their works.

Recognised specialist services associations shall include the following:

- The Fire Industry Association (FIA) incorporating the British Fire Protection Systems Association (BFPSA) and Fire Extinguishers Trades Association (FETA).
- British Approvals for Fire Equipment (BAFE).
- National Security Inspectorate (NSI).
- British Security Industry Association (BSIA).
- The Association of Lightning and Access Specialists (ATLAS).
- The Federation of Environmental Trade Associations (FETA).
- The Building Controls Industry Association (BCIA).

1.04 Health and Safety at Work

Compliance with the Health and Safety at Work Act shall be ensured. Prior to starting the work, a copy of the Contractor's Safety Policy Statement and details of his arrangements for securing compliance with the terms of the statement shall be supplied to the Contract Administrator.

The Contractor, together with any System Specialist appointed directly or indirectly through the contract, shall provide Risk Assessments, Method Statements and any other information relating to health and safety issues, as may be requested by the Contract Administrator Engineer, Principal Designer or Health and Safety Officer.

The information shall be provided in good time to allow for comments by the appropriate parties without delay to the progress of the work.

1.05 British Standards

All accessories equipment and materials used to complete the works shall be in full compliance with the appropriate British Standard Specifications.

The installations shall be carried out fully in accordance with the relevant codes of practice issued by the British Standards Institution.

1.06 CDM Regulations

The Contractor shall conform to all aspects of the CDM Regulations 2015 and undertake to provide all reasonable information to the Main Contractor and Health and Safety Officer throughout the duration of the Contract.

The successful Contractor shall provide detailed Method Statements and Risk Assessments for the installation works, which shall be agreed with all project participants before work commences.

1.07 Building Regulation Compliance

The building and its services shall comply with Part L2A of The Building Regulations. A compliant 'design stage' SBEM calculation has been carried out based on the building and building services as detailed in this specification, tender drawings and associated architectural and electrical services specification drawings. Any Contractor led deviation to this will require the Contractor to provide their own compliance calculation and subsequent 'As Built' SBEM calculation, to the satisfaction of the Building Control officer.

1.08 Materials and Equipment

1.08.1 General

All materials and equipment shall be new and unused, and suitable for their intended purpose, unless otherwise noted in this specification or on the drawings.

The specification and drawings shall be read together. All quantities and items of equipment to be as detailed on the drawings and in the specification.

The Contractor shall be responsible for taking off his own quantities from the drawings and specification.

The Contractor shall be responsible for checking and confirming all quantities identified in manufacturer equipment quotations, including all quotations supplied or included with this contract.

1.08.2 Samples

The Contractor shall submit samples of proposed materials and equipment for approval before commencement of the works. The Contractor shall label each sample with the name and catalogue number where appropriate.

1.08.3 Builder's Work

All necessary holes, chases, plinths and cut-outs for accommodating the equipment, accessories and cabling as specified shall be provided, together with any other builder's work requirements referred to in the particular specification, shown on the drawings or indicated in the schedule of approximate builder's work where provided.

1.08.4 Drawings

This Particular Specification and drawings are intended for costing purposes only and indicate the minimum acceptable requirements.

The drawings listed in Section 3 of this specification are representative of the work to be done and when read in conjunction with the specification enable the Contractor to interpret the design of the works.

It should be noted that the drawings are essentially diagrammatic and are not intended to indicate the precise disposition of the services relative to the building structure or other building services.
Therefore, the Contractor shall make provision to provide fully co-ordinated installation drawings as defined within BSRIA guide "BG6 - A Design Framework for Building Services" to satisfy and comply fully with design activity stages 4, 5 and 6. These drawings shall be at a scale of 1:50 for all general areas.

As defined within design activity stage 4, 5 and 6, the Contractor shall prepare fully co-ordinated installation drawings, builders work details, commissioning specifications and record drawings.

The fully co-ordinated installation drawings defined within BSRIA guide BG6 shall include the inter-relationship of two or more engineering services and their relation to the structure and building fabric.

The main features of the fully co-ordinated installation drawings shall be as follows:

- Plan layouts shall be to a scale of at least 1:50.
- The drawings shall make allowance for installation working space and space to facilitate commissioning and maintenance.
- The drawings shall be spatially co-ordinated and there should be no physical clashes between the system components when installed. Critical dimensions, datum levels and invert levels shall be provided.
- The drawings shall indicate positions of main fixing points and supports where they have significance to the structural design or spatial constraints

The Contractor shall submit the required fully co-ordinated installation drawings to the Project Engineer 4 weeks prior to anticipated commencement for comment. Any comments shall be provided within one week of receipt.

The Contractor shall keep on site a full set of drawings, which must be kept in line with current revision status. All revisions of drawings must be available on site for interrogation if so required by Align Property Partners.

The Contractor shall keep a concise record, as the work proceeds, of any part of the installation that is not in accordance with the original design and fully co-ordinated installation drawings.

It shall be the Contractor’s responsibility to update any changes or revisions and capture these on the fully co-ordinated installation drawings.

Prior to practical completion, the Contractor shall prepare, and ensure that all System Specialists appointed under the Contract prepare, ‘As Installed’ drawings and operation and maintenance manuals in electronic format for the final electrical services installation. The Contractor shall include 4No paper prints and electronic copies of each of the drawings in the Operation and maintenance manuals.

The fully co-ordinated installation drawings may be used as the basis for the ‘As Installed’ drawings, however they shall accurately represent the completed scheme and incorporate all revisions made during the contract period inclusive of alterations made during the defects liability period.

Drawings will not be issued to the Contractor in Revit or AutoCAD format and the Contractor and all associated Sub-Contractors and System Specialists shall therefore make full allowance in their costings for the preparation of independent Revit or AutoCAD drawings as applicable.

1.08.5 Finalised Position of Points

The Contractor shall note that the positions of all points and equipment shown on the drawings are approximate only and for guidance in preparing their costings.

The Contractor shall allow within their costings for the movement of all points and equipment up to a radius of 2000mm from the positions shown on the drawings without any cost variation.

The Contractor shall indicate the final positions of all outlets and equipment together with the routes and arrangements of cables and containment on site for the approval of the Contract Administrator. These must be agreed before installation commences.

The Contractor shall be responsible for liaising with all other trades and system specialists and be responsible for checking the final position of all outlets and equipment prior to commencement of the installation. The Contractor shall be held responsible for any alterations necessary due to non-compliance with the requirements of this clause.

1.08.6 Inspection of Installations

The Contractor shall afford every facility to the Contract Administrator to examine the works. Where any doubt exists as to the quality of materials used or the workmanship, the Contractor is to open up and expose any part of the work necessary for inspection, either during progress or on completion. Any items of work found to be unsatisfactory or sub-standard shall be removed and replaced to the satisfaction of the Contract Administrator. All costs for exposing of the work, remedial work and making good shall be borne by the Contractor.

1.08.7 Instruction in the Use of Installations

On completion of the installation, the Contractor shall provide detailed instructions and training in the operation and control of the entire electrical services provisions to the Employer's designated representatives in charge of the installation, together with their key staff. This shall be in the form of an organised workshop for all relevant personnel.

The Contractor shall allow for completing the soft landing documentation contained within Appendix C of this Specification. The checklist in Appendix C shall be developed by the Contractor during the project with additional items added to provide a complete checklist for all electrical services. The Contractor shall allow for instructing the Employer's staff in the correct operation of all individual systems and subsequently carrying out a written test for all systems. This procedure must be repeated until the Employer's staff are deemed to satisfactorily carry out all tasks.

The information imparted under this exercise shall be formally recorded in the Operation and Maintenance documentation.

The Contractor shall provide all information required for the safe operation and maintenance of the building in relation to the Contract Works, including any effects the Contract Works have on other building elements, operational requirements and systems.

The information shall comprise a Building Manual to meet the objectives of the Principal Designer, the Health and Safety File, the operational and maintenance requirements, and the Building Log Book requirements in accordance with Building Regulations Approved Documents.

For all equipment offered, the Main Contractor, Contractor and System Specialists shall instruct, train and fully demonstrate the operation of all systems to representatives of the employer, and provide such tuition and instruction as is necessary for the safe and satisfactory operation and maintenance of plant and equipment.

Depending upon the types of system, training may include courses at the manufacturer's premises or simple written and verbal instructions.

The cost of training shall be included by the Contractor relevant to the associated works.

1.08.8 Contents of the Building Manual

The Building Manual shall include but not be limited to the following:

- Index to Contents (applicable to all sections)
- List of record drawings (applicable to all sections)
- Requirements of applicable sections of the CDM Advisor's Pre Construction Information (PCI) document which will be passed to the Principal Contractor.
- Details of the property (applicable to all sections)
- The parties and project participants (applicable to all sections)
- Fire safety strategy
- Operational requirements and constraints of a general nature
- Building fabric details shall include:
  - i) Building fabric details
  - ii) Design criteria
  - iii) Detailed operational requirements and maintenance details and instructions
  - iv) Product details
  - v) Environmental and trafficking conditions

Building services details shall include:

- Description and operation of products, plant and systems including a full description of all plant, associated systems and operational routines including design conditions and control set points.
- Design description and performance data including test results and commissioning certification.
- Diagrammatic drawings
- Record drawings "As Built"
- Schedules and charts
- Schedule of services and identification codes
- Identification of services
- Product details with serial numbers an order numbers etc.
- Manufacturer and supplier directory with indexed technical literature including manufacturers' names, addresses and telephone numbers etc.
- Detailed description of control systems and modes of operation.
- Operational instructions for all plant specific to the project, (generic instructions are not acceptable)
- Equipment settings
- Preventative maintenance schedules listed in order of frequency.
- Reactive maintenance instructions
- Consumable items
- Recommended spares list including where replacements may be obtained locally.
- Fault tracing procedures
- Environmental actions and procedures during use maintenance, demolition and disposal
- Health and Safety procedures during use maintenance, demolition and disposal
- Emergency procedures including a schedule of safety precautions to be taken during operation, maintenance, servicing and demolition.

All sections of the above documentation shall include:

- Guarantees
- Warranties
- Maintenance agreements

- Test certificates, commissioning certificates, seasonal commissioning certificates, completion certificates and reports

1.08.9 Timing and Presentation of Instruction Manuals

The Contractor shall provide and ensure that all System Specialists appointed under the Services Sub-Contract provide at least 14 days before completion, comprehensive Operating and Maintenance Instructions in draft format for comment. The Contractor shall collate and index all associated System Specialist documentation into the Electrical Services Manuals which shall be enclosed in durable hard backed ring binder covers with individual double sided pages inserted in clear plastic wallets.

The Operation and Maintenance manuals shall be produced in accordance with CIBSE and BSRIA guidance and instructions. The number of sets of instructions shall be as specified in the tender documents but in no instance shall be less than two sets.

One set of O&M instructions shall be submitted to the Client on CD for comment before final issue to the Client.

The final Operating and Maintenance Instructions shall be handed to the Client as a hard copy immediately prior to handover and practical completion of the Contract.

Where required under Section 3 of the Building Regulations Approved Document L2 and in conjunction with the Operating and Maintenance Instructions, the Main Contractor, together with the Contractor and System Specialists, shall provide a composite ‘Building Log-Book’, prepared in accordance with Approved Document L2.

The Logbook shall give details of the installed building services plant and controls, their method of operation and maintenance and other details that collectively enable energy consumption to be monitored and controlled.

Full details of information to be provided are detailed within Section 3 of the Building Regulations Approved Document L2.

The Contractor and System Specialists, shall provide A4 size, plastic covered, loose leaf, four ring binders or lever arch files with durable hard covers, each indexed, divided and appropriately cover titled and cross referenced.

Individual A4 pages shall be double sided and sequentially page numbered with each sheet inserted in a clear plastic wallet of high quality with pre-punched holes for insertion into the binder/file.

Selected drawings required to illustrate or locate items illustrated within the Manual shall be provided. Where larger than A3, the drawings are to be folded and accommodated within acceptable clear plastic wallets with pre-punched holes for insertion into the binder/file. The fold arrangement of the drawings shall be presented so that the drawing title and number are clearly visible without removal from the wallet or binder. Where drawings of A3 size are presented, they shall be inserted into A3 sized clear plastic wallets with pre-punched holes for insertion into the binder/file.

The drawing and wallet shall be folded with a double fold to present the drawing at A4 size with the drawing title and number clearly visible.

The main sets of “As Installed” drawings may form annexes to the Manual but shall be presented in the same format.

The complete building manual shall also be presented on a navigable DVD ROM in Portable Document File (PDF) format and shall include, in the same order, all documents, manufacturer’s literature, drawings and certification included in the hard copy. The DVD ROM shall be secured in a clear plastic wallet within the front of each copy of the building manual.

All building manual binders shall be clearly identified on the front cover and spine with the project name, the unique employer’s project reference number and Logo. The front cover shall also indicate Company

Logo(s) and full postal address details of the Client, Contract Administrator, Architect, and Services Engineering Consultant.

The Contractor and System Specialists shall supply permanently engraved labels to all electrical plant equipment and accessories and affix traffolyte type identification tags and labels to all electrical and specialist services equipment and accessories.

1.08.10 As Installed Drawings

In addition to the PDF formatted Building Manual and Drawings, duplicate “As Installed” drawings shall be provided in AutoCAD release 2007 or higher format on the same DVD ROM as the manuals.

These shall be drawn up on at least the same scale and with at least the same competency as the Contract drawings.

The drawings shall show the exact positions of apparatus, plant, equipment, switchgear, distribution boards, lighting, accessories, controls etc., to provide a comprehensive accurate record of the whole of the electrical installation.

Until Align Property Partners has approved these drawings, the Contract will not be deemed complete.

The Contractor shall make due allowance within their costings for the preparation of these drawings and for similar preparation of drawing from all System Specialist suppliers, installers and manufacturers.

1.08.11 Inspection, Testing and Commissioning

The Contractor, together with all associated System Specialists appointed through the Electrical Sub-Contract, shall comprehensively inspect, test and commission the whole of the Electrical Installation in accordance with BS 7671 together with all other relevant British Standards, CIBSE Guides, BSRIA Guides and Codes of Practice relevant to the installed service.

The Contractor shall make due allowance within their costings for all attendance required during commissioning, inspection and testing of the completed installation for all trades.

Particular attention shall be given to the attendance requirements between the Electrical Services elements. The Contractor shall be responsible for all electrical safety tests and interface performance proving associated with the Mechanical Services installation, all functional tests and electrical safety tests in relation to Mechanical Services controls and supplies from Mechanical Services control systems being the responsibility of the Mechanical Services Contractor in conjunction with his Controls Specialist.

All Contractors, Sub-Contractors and System Specialists shall be jointly responsible for presentation of a fully commissioned building services installation to the Employer.

1.08.12 Initial Testing and Commissioning

In addition to the testing and commissioning requirements detailed above and in the Particular Specification, the Contractor shall:

- Monitor and programme pre-commissioning, commissioning and, where necessary, re-commissioning on behalf of the Employer
- Ensure that all building systems are commissioned in line with current Building Regulations and all relevant BSRIA/CIBSE Commissioning codes and guidelines
- Account for the commissioning programme, responsibilities and criteria within the main programme of works
- Appoint an independent specialist commissioning manager to oversee and verify commissioning for all systems within the building.

The scope of the specialist-commissioning manager shall include:

- Design input: Commissionability reviews of mechanical services system installation drawings and designs (with provision of recommendations if required for any amendments to be made prior to finalisation of the building system designs)
- Commissioning management input to construction programming
- Commissioning management input during installation stages
- Management of commissioning, performance testing and handover/post-handover stages
- Provide the following documents to confirm that the commissioning requirements have been met:
    - A copy of a letter or commissioning responsibilities schedule confirming the appointment of a specialist commissioning manager and scope of their commissioning role.
    - A letter confirming all building systems present within the scheme and stating the specific standards and codes of practice for each system to which commissioning procedures are to comply with.
    - A copy of a commissioning schedule confirming the contractor's responsibilities to include the requirements of the commissioning programme, responsibilities and requirements within the main programme of works.
    - A copy of a commissioning schedule confirming the stages of the Controls commissioning procedures.
    - Pre-Commissioning and Commissioning records/reports confirming commissioning procedures have been executed in compliance with relevant standards and codes of practice to which commissioning procedures are to comply with (to include completed and signed pre-commissioning and commissioning checklists).
    - A copy of the main contract programme highlighting commissioning, performance testing and handover period.

1.08.13 Seasonal Testing and Commissioning

In addition to the testing and commissioning requirements set out above and in the Mechanical and Electrical Specifications, the Contractor shall:

- Ensure that the appointment of a specialist commissioning manager includes the following seasonal commissioning responsibilities over a minimum 12 month period, once the building becomes occupied:
- Testing of all building services under full load conditions, i.e. heating equipment in midwinter, cooling/ventilation equipment in mid-summer, and under part load conditions (spring/autumn).
- Testing carried out during periods of extreme (high or low) occupancy.
- Interviews with building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems.
- Re-commissioning of systems (following any work needed to serve revised loads), and incorporating any revisions in operating procedures into the O&M manuals.
- Review lighting output, at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.
- Take all reasonable steps to re-commission systems following the review and incorporate any relevant revisions in operating procedures into the O&M manuals.

1.08.14 Installation Certification

The Contractor shall make due allowance within their costings for providing all necessary inspection, testing and commissioning certification.

The Contractor undertaking the electrical works and testing shall be full ECA and NICEIC enrolled members.

Following inspection and testing of the installation and any corrective action found necessary, the Contractor shall issue an Electrical Installation Certificate required in accordance with BS 7671. Certification shall be as prescribed and illustrated within The Institute of Engineering and Technology Regulations (Current Edition) as published by the NICEIC or ECA. Certification must be in type written format. Hand written certification shall not be acceptable nor permitted.

Separate installation, inspection, test, commissioning and completion certificates shall be provided for electrical ancillary services as supplied and installed by the Contractor's Specialist, including but not limited to the following:-

- Electrical Installation
- Fire Alarms
- Emergency Lighting
- Intruder Systems
- Lightning Protection Systems
- Structured Voice and Data Wiring Systems
- Lighting Controls

1.08.15 Programme Sequence and Timing

The whole of the works shall be carried out within the period indicated in the Main Contract documentation and in accordance with the Main Contract programme of works, and shall make due allowance for any premium or overtime working hours necessary to complete the works within the Contract period whilst mitigating the disruption caused to operational facilities on the same site.

The Contractor and System Specialists shall provide a detailed programme for the works, which shall indicate in detail the project planning together with the order date and delivery period of any items of specified plant and materials, which may cause potential delay to the contract completion date.

Safety Health and Environment

The Contractor and Specialist Contractors shall include for all measures to ensure the Health Safety and Welfare of the occupants are maintained at all times.

The Contractor and Specialist Contractor shall provide all necessary barriers, hoardings, fencing, etc.

The Contractor shall ensure all emergency egress routes are maintained, all tools are safely stored at the end of each day, works area to be cordoned off and persons carrying out the works conduct themselves in an appropriate manner.

1.08.16 Identification and Labelling

All electrical control equipment, including distribution boards, control panels, isolators, valves, etc., shall be provided with labels suitably engraved with indelible characters (not less than 6mm high) indicating the purpose and/or use of the equipment i.e. "DB-KIT".

All labels shall be engraved on "Traffolyte" or similar, white with black lettering except for warning notices which shall be white with red letters, fixed with at least two chrome round headed screws. Self-adhesive labels shall not be used.

All distribution boards shall be provided with a substantial circuit chart enclosed in a clear Perspex or substantial plastic envelope firmly fixed to the inside front cover by a permanent adhesive.

All socket outlets and fused connection units shall be labelled with their circuit reference.

Where appropriate, "DANGER 400 VOLTS" labels shall be provided generally in accordance with this specification clause.

The Contractor shall supply and install all the statutory notices required with regard to electrical installations in a proprietary, substantial and permanent form, in addition to notices required by the IET Wiring Regulations.

Electric Shock Treatment signs shall be provided adjacent the service intake panel/distribution board. The sign shall be wall mounted with cup and screw fixings and shall be of the durable plastic type as Electrical Review/Electrical Times approved pattern. The Contractor shall also provide floor rubber matting, 6mm minimum thickness within each of the service cupboard partitions.

All electrical cupboard doors together with all removable covers to access plant, switchgear, terminal boxes etc. are to be lockable and secured such that they cannot be opened by hand without the use of a tool or key and shall be appropriately labelled to suit the services concealed "DANGER **** *****" in block capitals, with the appropriate risk, voltage potential given in the place of the asterisks.

Permanent labels shall be provided to all electrical accessories such as connection units, isolators, cooker control units, plant, equipment, control devices, panels and the like to identify their circuit designation and equipment served.

Ancillary services shall be labelled to show their purpose/use i.e., “Assisted Alarm Reset”

Fire alarm equipment and devices shall be labelled to show wiring sequence and address numbers together with identification of all end of line devices and remote indication.

1.08.17 Summary of Tender

The Contractor shall be required to fully complete and return with their costings the “Summary of Tender” for the Electrical Services included in the costing documentation. The costings shall be deemed to include any Prime Cost or Provisional Sums identified in the Tender Summary.

A copy of the Summary of Tender is included in the Appendices of this specification for information only and the Contractor shall refer to the Main Contractors formal Tender Return documentation for the formal Summary of Tender.

As part of the contract documentation, the successful tenderer shall produce a quantified schedule of rates for the electrical and Specialist Services. The schedule shall be fully completed, including all mark-ups, add-ons and discounts, and shall be multiplied out, and totalled, to agree with the submitted tender sum. Failure to comply with this requirement shall render the tender insertion void.

1.08.18 Alternative Equipment

At the time of making an offer the Tenderer shall have ascertained from the manufacturers or suppliers of all goods, materials and equipment that are specified by Align Property Partners that such goods, materials and equipment can be procured at the proper time or times suitable to meet the programme set out in the costings documents. If they cannot be so procured, the Contractor shall inform Align Property Partners so that alternative items can be sourced and specified or other arrangements made by Align Property Partners before the contract is awarded.

If products of different manufacture to those specified are proposed, the Contractor shall submit full details with the costings giving reasons for each proposed substitution. **Substitutions/equal to products, which have not been notified at costing stage, shall not be considered.**

The Tender sum shall only include for equipment from the manufacturers specified. Alternative manufacturers proposed by the Tenderer shall be detailed in the Schedule of Proposed Alternatives and the price difference stated. Upon approval of the alternative, the Tender sum shall be adjusted accordingly.

Align Property Partners reserve the right to withhold consent to use any firm proposed and shall inform the Contractor in writing of any such decision.

Where a system of installation, product, or item of equipment is specified as equal and approved, this shall be construed as setting the standard for that particular system, product or item of equipment.

The Contractor may submit an alternative to the specified item but shall do so separately to the “Summary of Tender” which shall include all specified services.

The separate submission shall include reasons and documentation to substantiate the submission including the effect on cost and programme compared with the specified system, product or item of equipment.

Relevant information required shall include:

- Manufacturer and product reference
- Cost
- Availability
- Relevant standards
- Performance
- Performance comparison with original specified product
- Function
- Compatibility of accessories
- Proposed revisions to drawings and specification
- Compatibility with adjacent work
- Appearance
- Copy of warranty/ guarantee

Alterations to adjacent work:

If needed, advise scope, nature, cost and programme implications.

Manufacturers' guarantees:

The Contractor and his appointed Specialist Services Contractor shall schedule all proposed alternatives with the submitted costings together with the cost addition/reduction applicable to the costing sum. Failure to comply with this requirement shall render the Tender insertion void.

SECTION 2 Electrical Standards

2.1 General Contents

The clauses in this section of the specification comprise the Standard Clauses detailing the performance specification of materials and the method, and minimum standard, of installation procedures to be adopted by the Contractor.

Compliance with these clauses is essential to all Contracts, but it is possible that a number of the clauses do not directly apply to this particular Contract.

All items, which are relevant to this Contract, must be strictly adhered to, and permission to deviate from any of these relevant clauses must be obtained in writing from the Engineer prior to commencing the works.

The method of Electrical Installation practice as detailed in this Section indicates the minimum standard of works, workmanship, materials and the only methods that shall be acceptable to the Architect and/or Engineer.

All clauses in the Particular Section of the specification apply directly to the particular Contract and must be read in conjunction with any relevant Clauses in this section.

This Standard Specification shall be read in conjunction with the specific Contract Conditions and/or Particular Specification for this particular contract.

In case of discrepancies, the Contract Conditions and/or Particular Specification shall take precedence.

2.2 Building Works

Unless otherwise indicated in this specification, the Contractor, at the instruction of the Main Contractor, shall be responsible for all cutting away of holes and chases in brickwork, concrete or other building materials and the excavating of trenches, draw pits and inspection pits for outside runs of cables/ducts and the subsequent reinstatement and resurfacing of trenches/pits and making good with relevant fabric/building material to match the area.

The Contractor, together with any System Specialist, shall be responsible for providing information to the Main Contractor relevant to the scheduling of all builders work associated with the Electrical Services.

The Contractor and System Specialist must obtain the permission of the Structural Engineer before drilling any holes/apertures/changes in structural steelwork or structural beams, columns or decks etc.

All holes through building fabric/walls, etc. must be cut as carefully as possible and made up solid after completion. Holes through ceilings and cornices, if applicable, must be bored from underneath to cause the least disturbance.

Chases in plaster, brickwork and concrete must be sufficiently deep to provide 13mm covering to all conduits and fastenings, be neatly executed, and of minimum width.

The cost of all unnecessary cutting away and making good occasioned by faulty marking out and/or incorrect instructions being given by the Contractor and System Specialist shall not be chargeable to Align Property Partners and shall be borne by the Contractor and System Specialist.

The Contractor and System Specialist shall provide plant and equipment foundation drawings for items supplied under the Contract/Sub-Contract and any other builders work drawings necessary for the correct and efficient execution of the work.

The Contractor and System Specialist shall be responsible for the design, supply and installation of all necessary fixings, brackets, supports, braces, hangers etc. as may be necessary to complete the installation as shown on the drawings.

The Contractor and System Specialist shall provide full details of all holes, ducts chases etc., to Align Property Partners for approval prior to commencement of any builders works. All dimensions shall be verified on site.

2.3 Class of Work

All work carried out under the Contract shall be executed in the manner detailed in the specification, or where not detailed, to the complete satisfaction of the Engineer.

All works shall conform to the best principles of modern practice and shall be carried out by fully competent tradesmen.

The whole of the work shall be carried out in strict accordance with:-

- BS 7671 – Requirements for Electrical Installations – IET Wiring Regulations 18th Edition (hereinafter referred to as the IET Wiring Regulations) including all amendments.
- The Electricity at Work Regulations 1989.
- Other British Standards relevant to particular sections of the contract (e.g. BS 5839 Fire Detection and Alarm Systems for Buildings, BS 5266 Emergency Lighting etc.).

2.4 Progress, Supervision and Workmen

On receipt of the order, the Contractor shall take steps to acquaint themselves with the general construction and details of the work of other trades on site, in particular the ventilation, heating, gas and plumbing Contractors, in order to ensure that these works shall not in any way hinder or obstruct the electrical work as planned and specified.

All site works shall be fully and properly supervised by a Supervising Electrical Engineer who shall ensure that progress is maintained and shall attend site meetings as required and shall programme the work.

The Supervising Electrical Engineer shall be fully competent to discuss and consider with the Engineer all items which may arise under the Contract in respect of the mutual manner in which the work is being executed and shall be capable of making decisions to ensure that the installation is carried out diligently and complies with the terms of the Contract.

The Contactor shall convene daily meetings with all sub-contractors under their control to determine that all proposed activities programmed for that particular day have all the appropriate authorised documentation in place and suitably trained people to carry out the works.

2.5 Materials

All materials shall be in accordance with the type and manufacture described in the specification, the clients approved list of manufacturers and/or shown on the relevant drawings.

Where the Contractor proposes to use materials differing from those described, he shall first obtain the written approval of the Engineer.

Materials shall comply fully with the relevant British Standard Specification, unless otherwise described in the particular specification and/or on the drawings.

The Engineer reserves the right to inspect materials on site and to reject any materials not complying with the specification. The cost of any dismantling and re-erection of the installation shall be borne by the Contractor concerned

2.6 Design Conditions

2.6.1 Voltage Drop

Conductors shall be sized to ensure compliance with Section 525-1 of the IET Wiring Regulations.

2.6.2 Load Balancing

The Electrical Installation shall be designed and installed to provide balanced loads across the phases as far as possible.

Where an additional load is introduced during the contract period, this shall be connected to maintain the balanced electrical load, having due regard to phasing and safety within the premises.

2.6.3 Distorting Loads

Where distorting loads, e.g. UPS, IT equipment, telecommunication equipment etc., are to be installed as part of the works, the Contractor shall measure the level of existing voltage distortion and harmonic current content at the source of supply within the site/building and report his findings to the Engineer.

The measurements, and reporting to the Engineer, shall take place prior to commencement of the works.

2.7 Supply Authority Connections

Connections between the main switchgear and the Supply Authority metering equipment shall consist of one of the following:-

a) Where required by the particular section of the project specification, suitable provision shall be made on the main switchgear to accept the Supply Authority's equipment and all interconnecting wiring within the panel shall be provided.

   Interconnecting wiring shall be in accordance with the IET Wiring Regulations and the local Supply Authority requirements.

b) Where the Supply Authority provides a meter cubicle independent of the main switchgear, the Contractor shall install an adequately sized steel trunking between the meter cubicle and the main switchgear to contain the meter connections.

c) In instances where no meter cubicle is to be provided by the Supply Authority, the Contractor shall provide and install a suitable wall mounted backboard and steel trunking, onto which meters shall be mounted directly with meter connections enclosed in the trunking provided.

2.8 Earthing

2.8.1 General

The whole of the metallic portion of the installation, other than current carrying parts, shall be electrically and mechanically bonded to the consumer's main earth terminal and also, if applicable, to the lightning protection system or other points specified.

The installation shall be earthed in accordance with:

1. British Standard BS 7671: Requirements for Electrical Installations.
2. British Standard BS 7430: Code of Practice for Earthing.
3. British Standard BS EN 62305-1: Code of Practice for Protection of Structures against Lightning.

The Contractor's attention is drawn to Chapter 54 of BS7671.

All materials and sundry items shall be provided, whether or not specifically mentioned, necessary to completely and effectively earth the installation.

The installation shall be fully protected against dampness, corrosion, and the effects of electrolytic action between dissimilar materials.

A complete, permanent installation shall be provided which shall be fully accessible for regular testing and inspection.

For new installations, a main earth bar should be provided at the incoming electrical service position.

This main earth bar shall be mounted on insulated supports and shall be adequately sized to terminate all bonding conductors in separate terminations.

Grouping of connections shall not be permitted. The bar shall be adequately sized to allow for 30% spare holes (minimum of two).

A main earthing conductor, sized in accordance with BS 7671, shall be supplied and installed between the incoming electricity supply cable to the main earth bar.

This earthing conductor shall be terminated using a heavy duty copper clamp to BS 951.

All bonding conductors shall be LSZH insulated copper core cables, coloured green and yellow, labelled in accordance with BS 7671.

To provide mechanical protection all bonding conductors, where possible, shall be enclosed within metal conduit or trunking or installed on cable tray. Single core bonding conductors shall not be installed within metal conduits on their own.

Earth tapes shall be installed within plant rooms and switch rooms. Earth tapes shall be installed with a clearance of 3mm to the structure. Fixing distances shall be 450mm maximum.

2.8.2 Equipotential Bonding Conductors

All switchgear and control panel cabinets and all metal piped services, e.g. heating, water, gas, oil and waste disposal shall be provided with a main equipotential bonding conductor connected to the main earth bar.

A 50mm long section of each metal gas, water and oil pipe, at positions close to their entry into the building, on the consumer's side of the supply authority's valves and metering, shall be cleaned and made smooth. A copper earthing clamp, designed to permit the connection of protective conductors, shall be provided. The clamp shall be a proprietary type or shall be fabricated from high conductivity copper strip, minimum size 40mm x 4mm, which shall encircle the cleaned sections of the pipe.

40mm x 10mm brass bolts shall pass through 10mm holes drilled in the end return sections of each clamp and brass bolt, washer and nut shall tighten the clamp on to the pipe.

A permanent label, indelibly marked with the words "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in legible type not less than 4.75mm high, shall be permanently fixed at the points of connection.

The final connection of bonding conductors from gas, water, oil pipes and other services to the earth terminal shall not be completed until earth impedance tests have been satisfactorily completed.

2.8.3 Supplementary Bonding Conductor

All items with exposed conductive parts such as accessories, luminaires, conduits and the outer metallic sheaths and armouring of cables, together with all other items of electrical plant and equipment, shall be effectively earthed by means of a protective conductor, in accordance with Clause 544.2 of the IET Wiring Regulations.

At every terminal point on the fixed wiring system, e.g. BESA boxes, accessory boxes etc., an integral earth terminal shall be provided. A protective conductor shall be provided and installed between this terminal and the earth terminal on the associated switch, socket outlet, luminaire etc.

Each circuit protective conductor shall be connected to a multi-way dual earth bar provided, and fixed, within each distribution board to accommodate high integrity earthing.

The earth bar shall be provided with an adequate number of ways to ensure that not more than one conductor per terminal is installed.

The earthing conductors shall be connected in the same sequence as the circuit current carrying conductors and each earth terminal shall be numbered.

Where distribution boards serve ring main circuits, which require separate termination of each protective conductor, the Contractor, shall ensure that the boards are fitted with adequately sized earth bars.

2.8.4 Bonding Conductor Installation Methods

Connection between each earth clamp and the consumers main earthing terminal shall be made by LSZH insulated stranded copper cables. Each end shall be terminated in a sweated or crimped cable socket and connection to pipe clamps and earthing terminals shall be made onto the studs or bolts using brass nuts, washers and locknuts.

Connections between dissimilar metals are to be avoided. If unavoidable, they shall have the faces coated with petroleum jelly or similar neutral grease and in the event of copper being present, it shall be tinned.

Bonding connections to pipework shall be as unobtrusive as possible and, where practicable, shall be made in service ducts or accessible voids and shall be readily accessible. The locations shall be indicated on the As Installed drawings.

The metal waste of all sinks and basins shall be bonded to the hot and cold water pipes. The cables shall run to be as inconspicuous as possible.

All equipment located in kitchens and toilets e.g. cookers, hand dryers etc. shall have an additional supplementary bonding conductor interconnecting all pipework and the main earth terminal.

All earth bonding connections and safety earth labels shall be clearly visible at all times and shall not be covered by paint or lagging or otherwise obscured.

2.8.5 Bonding to Lightning Protection System

Connections to lightning conductors shall be as detailed in the British Standard BS EN 62305-1: Protection against Lightning and the Particular Specification.

2.8.6 Protective Multiple Earthing Systems

The provision of protective multiple earthing shall be in accordance with the Electricity Supply Authority and as detailed in the Particular Specification, where applicable.

2.9 Switchgear and Distribution Equipment

2.9.1 General

All switchboards and control panels shall be constructed to ensure that they can be placed into position without alterations to the building. Where necessary, the switchboards and control panels shall be supplied in sections and built on site.

Main switchboards and control panels shall be fixed to the wall/floor by means of rawl bolts or other approved fixings.

Switchboards and control panels shall be delivered to site when required to suit the progress of the works.

Care should be taken to preserve the manufacturer's paint finish. Any refurbishing etc. shall be carried out using paint obtained from the switchboard/control panel manufacturer to the original standard of finish.

All cable connections to the switchboards and control panels shall be installed without reduction in cross sectional area.

Appropriately sized cable lugs and terminals shall be provided, or the manufacturer, to accept larger cables than standard, shall modify equipment. Provision is to be made for a minimum of 25% spare capacity for future fitting of additional switchgear. Any larger requirements shall be detailed in the Particular Specification.

All distribution boards shall be surface or flush type as specified, and of the sizes as detailed on the drawings.

Facilities for local isolation of the distribution boards shall be provided by either a local fused switch or an integral isolating switch, as indicated on the drawings.

Where surface mounted on a flush installation, all flush containment shall terminate behind the distribution board in a large, flush mounted adaptable box to ensure good cable management within the distribution board.

For surface mounting, trunking shall be fixed between the distribution board and ceiling level, or conduits run directly into the distribution board. Adequate earth continuity connection shall be made between the various components.

Equipment within the switchboards shall comply with the following current British Standards:

ACBs	-	BS EN 60947-2
MCCBs	-	BS EN 60947-2
Fuse switches	-	BS EN 60947-3
HRC fuses	-	BS 88
MCBs	-	BS EN 60898-2
Contactors	-	BS EN 60947-4-1
Current Transformers	-	BS EN 60044-1
Protection Relays	-	BS 142

2.9.2 Main Switchboards

Main switchboards shall be constructed in accordance with BS EN 60439-1, minimum Form 4 Type 6, or as detailed in the Particular Specification.

Switchboard sections shall consist of individually constructed assemblies, with the main structural components fabricated from rolled steel channel or equivalent angle section, clad with steel of minimum 2mm thickness.

Removable panels shall be provided for easy access for assembly. Adequate space shall be provided for cable terminations.

The neutral bus-bar current rating shall be 100% of the main bus-bars, unless detailed otherwise in the Particular Specification. The earth bar rating shall be 25% of the main bus-bars, unless detailed otherwise in the Particular Specification.

Gland plates shall be removable and generally of plated steel, except where single core cables are required to terminate on the panel, in which case aluminium plates shall be provided or the steel plates modified to suit.

The degree of protection shall generally be IP31 to BS EN 60947-2 unless specified otherwise in the Particular Specification.

Where terminals are provided for outgoing cables, they should be of the Weidmuller standard rail mounted feed through type or equal and approved.

All terminals shall be identified by means of numbering or lettered marking tags, which shall be identical to the numbers or letters applied to the cables. Cables should be identified at terminations by means of cable markers manufactured by Weidmuller, Critchley, or equal and approved. A 25% spare terminal capacity shall be included for future usage.

Multiple runs of minor flexible cords within panels shall be neatly loomed on doors and contained in flame retardant ducting. Elsewhere in the panel, 50% spare capacity within wiring ducts shall be provided.

All components, motor switches, relays, timers etc, shall be labelled showing their reference and function and these shall relate to the power schematic wiring diagram provided with the As Installed drawings and Operating and Maintenance manuals.

2.9.3 Control Panels

Control Panels shall generally comply with the requirements for main switchboards where applicable.
All control panels shall be fitted with multiple isolating switches, through which all electricity supplies shall pass. The door/doors to the control panel shall not open unless the isolating switch is in the "off" position. A facility to lock the control panel isolating switch in the "off" position shall be included.

2.9.4 Distribution Boards and Consumer Units

Distribution boards and consumer units shall comply with BS EN 60439-3. The distribution board and consumer unit enclosures shall be constructed of heavy gauge sheet steel, to afford rigidity and maximum ease of wiring for full size final circuit and sub-main cables. Each distribution board and consumer unit shall only incorporate devices and components declared suitable according to the assembly manufacturer’s instructions or literature in accordance with clause 536.4.203 of BS 7671.

The distribution boards and consumer units shall be capable of accepting MCBs, RCDs and AFFDs. Where facilities for MCBs are specified below, this requirement is also necessary for RCDs and AFFDs.

The cover shall be provided with an efficient gasket, or alternatively designed with generous overlapping edges, to prevent the ingress of dust.

Components shall not be manufactured from zinc alloy in conjunction with sheet steel where they are relied upon for earth continuity. The enclosure shall be provided with a hinged steel door.

Cylinder type locks shall be provided on each distribution board, having two keys per lock. A master key shall operate all locks. Six keys shall be handed to the Engineer upon completion of the Contract.

The enclosure shall be provided with detachable cable/conduit terminating plates, which shall be reversible and interchangeable from top to bottom. Alternatively, knockouts shall be provided.

All screws and nuts used in the construction of the enclosure shall be fitted with shakeproof washers and care shall be taken to ensure efficient earth continuity.

All MCB banks shall be fitted to frames with robust locking plates, provided to secure the frames rigidly in the fixed positions.

The MCB banks shall be spaced to remove the necessity for insulating barriers. Protection shall be provided by means of insulating shields to prevent accidental contact with the main bus-bars and incoming main cable.

Bus-bars shall be of high conductivity, hard drawn copper conductors connected to the MCB contacts by means of spring screws or bolts, unless plug in type MCBs are specified.

Where a main integral isolating switch is provided in an MCB enclosure, it shall be arranged to isolate incoming live and neutral main cables from the bus-bars.

The isolator switch shall be rated at 500 Volts and be of the quick make-and-break pattern with positive action. Incoming and outgoing terminals shall be fitted with two clamping screws, and outgoing conductors from the bus-bars shall be high conductivity hard drawn copper.

Isolating switches shall comply with BS 7671 Section 537 and shall be capable of carrying the full load continuously and shall "make" or "break" the full rated load without undue burning of the contacts. Four pole isolators shall be used for three phase and neutral installations.

The isolating distances between contacts when in the open position shall not be less than those specified for isolators in BS EN 60947-3.

Neutral bars shall be similar to the main bus-bars and shall have two screw terminals per way for ratings of 30A or over.

Single screw connections shall be allowed for connections up to 30A. The neutral bars shall have one terminal for each MCB way within the board, and connection of conductors to the neutral bar shall be in the same order as the MCB ways.

The neutral bar terminals shall be numbered in line with the number of ways within the distribution board.

All distribution boards shall also contain dual internal earthing bars, similar to the neutral bars detailed above, to allow both earth conductors to be terminated for any circuits requiring high integrity earthing. Earthing conductors shall be connected in the manner described for neutral conductors. The earthing bar terminals shall be numbered in line with the neutral bar numbering.

2.9.5 Fused Switches, Switch Fuses and Switches

All fused switches, switch fuses and switches shall comply with BS EN 60947-3 and shall be 500 Volt type.

All switchgear shall be provided with suitable locks for padlocking the switches in the "OFF" position. The cover shall be interlocked with the operating mechanism to prevent it from being opened in the "ON" position.

This interlocking shall also prevent the switch from being closed with the cover open, unless the mechanism is operated by an authorised person for examination and maintenance purposes.

The cover shall be gasketted to prevent ingress of dust.

The switch action shall be of the ‘quick break’, on load design and shall be ASTA certified to adequately meet all required duties as specified.

Gland plates shall be removable for drilling for conduit or cable entry and shall be fitted with additional distance pieces where necessary.

All fuses in switchgear shall be BS 88 HRC gG type, sized as specified or as detailed on the drawings for the fused switch units or switch fuses in which they are incorporated. They shall be ASTA certified for compliance with BS 88 Category of Duty 440V AC5 Class Q1. Fuses shall be selected to provide short circuit protection and discrimination with upstream and downstream devices.

2.9.6 Moulded Case Circuit Breakers (MCCBs)

All MCCBs shall be rated at 500 Volts minimum, be ASTA certified for the operation duty, comply with BS EN 60947-2 and include the following:

- MCCBs shall be manufactured in accordance with IEC 947-2.
- MCCBs shall have an ultimate breaking capacity at least equal to that of the system.
- Four pole MCCBs shall incorporate an early make late break neutral in accordance with IEC947-2
- Thermal magnetic MCCBs shall be adjustable between 63-100% of the rated current and be available up to 800 Amp.
- Electronic MCCB trip units shall provide adjustment in both the time and current domain for the LTD and STD segments of the MCCB curve. The INST segment of the curve shall be adjustable in the current domain. Generally, the protection unit should be adjustable between 50-100% of the rated current.
- MCCBs shall provide positive contact indication via the toggle mechanism. All three positions of the breaker shall be clearly indicated on the facia i.e. On, Off and Tripped.
- All MCCB protection units shall be unaffected by harmonics up to the 19th harmonic.
- All electronic MCCBs shall be category B in line with IEC 947-2.

The following options should be included:

- LED indication shall be provided on the front of the electronic trip unit indicating the cause of the MCCB trip. i.e. LTD, STD etc.
- Pre-trip alarm shall be included within the electronic MCCB trip unit and shall be adjustable between 75-100% of the rated current.
- MCCBs shall be plug-in type with personnel protection to IP2X.

MCCBs shall be either of the thermal/magnetic type or electronic trip unit type, having a quick make, quick break, trip free mechanism which prevents the MCCB from being closed or held in against short circuits or overloads. Tripping of every multi-pole MCCB shall be such that operation ensures simultaneous action in all phases.

The operation shall be such that the MCCB shall trip automatically under fault conditions and to re-set, the operating handle shall require first moving through the ‘OFF' position. All MCCBs shall be provided with facilities for locking in the ‘OFF' position.

MCCBs shall be of the current limiting type to provide short circuit protection to downstream MCCBs.

Circuit breakers protecting 2 or 3 phase circuits shall be of the multi-phase type. Multi-phase circuit breakers shall not be employed in single phase circuits.

Where the full capacity of a panelboards is not required, the Contractor shall allow for fixing blanking plates in vacant MCCB housings.

2.9.7 Miniature Circuit Breakers (MCBs)

All MCBs shall be rated 500 Volts minimum and comply with BS EN60898-2.

MCBs shall be of thermal/magnetic type having a quick make, quick break, trip free mechanism which prevents the MCB being closed or held in against short circuits or overloads.

Tripping of every multi-pole MCB shall be such that operation ensures simultaneous action in all phases.

All MCBs shall be of a minimum 16kA breaking capacity, or as detailed in the Particular Specification.

Circuit breakers protecting 2 or 3 phase circuits shall be of the multi-phase type. Multi-phase circuit breakers shall not be employed in single phase circuits.

Where the full capacity of the distribution board is not required, the Contractor shall allow for fixing blanking plates in the vacant MCB housings.

2.9.8 Arc Fault Detection Devices (AFDDs)

All AFDDs shall be manufactured in accordance with BS EN 62606 and shall be provided as a means of providing additional protection against fires caused by arc faults in AC single phase final circuits.

Where required by clause 421.1.7 of BS7671, AFDDs shall be placed at the origin of the circuit to be protected. Areas where AFDDs can be used include:-

- Premises with sleeping accommodation
- Locations with a risk of fire due to the nature of processed or stored materials
- Locations with combustible constructional materials
- Fire propagating structures
- Locations with endangering of irreplaceable goods.

2.9.9 Residual Current Devices (RCDs)

RCDs with a rated residual operating current not exceeding 30mA are recognised as additional protection in compliance with Regulation 415.1 of BS 7671. RCDs shall be manufactured in accordance with BS EN 61008, BS EN 61009 or BS EN 62423. The types of RCD for particular circuits are as follows:-

- Type A for general equipment
- Type B for electric vehicle chargers and photovoltaic system supplies
- Type F for equipment with frequency controlled speed drives

2.9.10 Surge Protection Devices (SPDs)

Surge protection devices shall be provided to protect the installation against transient overvoltage in accordance with Regulation 443.4 of BS 7671. SPDs shall be in accordance with BS EN 61643-11 and shall be installed where the consequence caused by overvoltage could:-

- Result in serious injury to, or loss of, human life, or;
- Result in interruption of public services and/or damage to cultural heritage, or
- Result in interruption of commercial or industrial activity, or
- Affect a large number of co-located individuals.

2.10 Cable Containment Systems

2.10.1 General

All trunking shall only be installed in situations which shall remain readily accessible throughout the life of the building. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

2.10.2 Steel Cable Trunking

Steel cable trunking shall comply with BS EN 50085-1. Steel underfloor trunking shall be in accordance with BS 4678 Part 2.

Sheet steel cable trunking may be used on installations employing steel conduits, for connecting two or more switchboards together or where several conduits would otherwise have to be run alongside each other.

The Contractor must make due allowance for the derating of cables installed together in a trunking system. The cables must be capable of carrying the current imposed by the equipment connected.

All lengths of trunking shall be heavy gauge zinc coated steel connected together by internally fitted rectangular couplings of sufficient width to provide a minimum bearing face of 25mm to which the lengths shall be bolted on site or welded at the factory.

Adequate provision shall be made to allow for expansion.

All necessary accessories including long sleeve couplings, end pieces, bends, sets, tees, reducers, branches, fillets, pinracks, cable retainers, hangers, brackets etc. shall be allowed for in the costings, and shall be purpose made units rather than being fabricated on site.

Trunking shall be firmly attached to its associated equipment either by bolted flanges or by male bushes and couplings.

Where trunking is connected to equipment by means of flange connectors, the entry into the equipment shall be of the same cross section as the trunking.

Where trunking does not terminate in equipment, the open end shall be capped with a cover suitably bolted in position.

All tee pieces and bends shall be formed with similar means of connection and the inner radius area shall be such that cables shall not be bent through a radius less than that prescribed in BS 7671. Only bends and tees of approved pattern shall be accepted.

Where a change in direction of trunking run occurs, the deviation shall be effected by a purpose made unit manufactured on similar lines to the bends and tee pieces described above.

Where this is not practical, changes in direction shall be fabricated in a neat and workmanlike manner.

All joints shall fit closely and gaps shall not be permitted. All burrs and sharp edges shall be removed and no screws shall protrude into the trunking.

Where trunking is required to be recessed in the structure of the building, the finished edge of the trunking shall be installed flush with the plasterwork.

Trunking runs shall be so arranged that the lid or cover plate is always on the top or side and not underneath, unless this cannot be avoided, in which case the Engineer’s permission shall be obtained.

Wherever trunking passes through walls, vertical partitions etc., a fixed piece of trunking lid shall be fitted to the trunking extending 25mm either side of the wall or other barrier. This is to allow removal of the adjacent lid without disturbing the building fabric.

Care shall be taken to ensure that no orifice remains between the trunking and the building structure through which fire might spread.

Fire barriers in accordance with BS 7671 section 527.2 shall be installed where trunking is routed between fire compartments e.g. floors, walls, fire curtains etc. Insulated cable support pins shall be fitted at intervals of 4 metres in vertical runs of trunking.

The entire trunking system shall be electrically and mechanically continuous throughout.

Earth links of the appropriate size and type shall be installed at every jointing coupling, manufactured bend, tee etc., throughout the entire trunking system.

Steel cable trunking shall be bonded by supplementary bonding conductors. The steel cable trunking shall not be used as a circuit protective conductor.

All fixing screws within the trunking shall be of the round head type. The trunking shall have an overlapping, well fitted lid securely fixed to the trunking by approved means to avoid damage to the cables. Self-tapping screws shall not be used.

In cases where sheet steel trunking is installed where there is a danger of movement, a flexible earth conductor shall be installed bonding all joints in the trunking. This shall be fitted in addition to the standard earth links. Cable retaining strips shall be fitted at 1 metre intervals.

Where communications, extra low voltage circuits etc., are contained in a trunking, the required number of separate compartments shall be provided to segregate the wiring. Where conduits are taken off such trunking, they shall not pass through other compartments.

2.10.3 PVC Cable Trunking

PVC trunking and accessories shall comply with the physical tests contained in BS 4678 Part 4 "Non-metallic conduits and fittings for electrical installations".

The insulated trunking shall only be used where an insulated conduit system is being installed, unless specifically stated otherwise. The trunking shall be fixed by means of metal screws at intervals not exceeding 1 metre.

Fixing holes shall be slotted to allow for any subsequent expansion due to temperature variations. Insulated trunking shall not be installed where ambient temperatures are expected to exceed +60° C or fall below -5° C.

Care shall be taken to ensure that the trunking is not deformed by fixings. This applies particularly when trunking is fixed to an uneven surface. Packing pieces shall be securely fixed level and plumb without being deformed.

Insulated cable trunking shall be of the high impact resisting heavy gauge type fitted with well fitted lids of an approved type and size or as indicated in the specification, schedules or drawings.

Cable retaining strips shall be fitted at 1 metre intervals unless trunking is installed with the cover on the top side. Insulated cable support pins shall be fitted at intervals of 4 metres in vertical runs of trunking and at the top of the vertical trunking.

Fire barriers in accordance with BS 7671 section 527.2 shall be fitted where vertical trunking passes through fire compartments for example floors, walls, fire curtains, etc.

Overlapping cover plates shall be fitted where installed flush with the building fabric. The finished edge of the trunking shall finish flush with the finished surface.

Insulated trunking shall be fitted with manufacturer’s standard tees, offsets and other fittings where changes of direction occur. Trunking shall be fitted with manufacturer’s standard end plates.

Joints shall be effected using manufacturers standard internal connectors, and in accordance with the manufacturers recommendations.

Installation shall be in accordance with the appropriate conditions covering the installations of insulated conduit. Allowance shall be made for expansion.

The manufacturer’s recommendations regarding the installation of insulated trunking must be adhered to at all times.

Separate circuit protective conductors shall be installed in the trunking.

All joints and fabricated bends etc, in insulated trunking shall be made in a neat and workmanlike manner and all joints in trunking and trunking cover shall fit closely and be free from gaps. Additional fixing shall be provided to the building structure 50mm either side of the joint.

Joints in the lid and trunking must not be allowed to coincide.

Trunking shall only by installed in situations which shall remain readily accessible throughout the life of the building. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

All conduit entries shall be made by means of purpose made bushes and couplings or adapters.

2.10.4 Steel Cable Trays

Cable trays shall be manufactured in accordance with BS EN 61537, formed of perforated steel of not less than 0.9mm thickness up to and including 100mm width, 1.25mm thickness from 150mm up to and including 300mm width, and 2.00mm thickness above 300mm width. They shall be galvanised unless otherwise indicated in the Particular Specification.

Tray shall be adequately sized to support the cables without bunching. A 25% spare capacity in size and weight shall be allowed for all cable tray works.

Support shall be by means of steel brackets to BS 6946 installed at intervals necessary to provide a rigid fixing and ensure that no undue deflection occurs in the complete installation.

Dome headed bolts, nuts, and washers of finish suitable to the tray shall be used between tray and brackets.

Fixing of the cable tray support system to the building fabric shall be by means of expansion type masonry plugs or bolts. Fixings shall be galvanised unless otherwise stated.

Cable trays shall be installed using factory formed bends of the same material thickness and finish. Where cut sections are used for sets, they shall be free from sharp edges and joined by means of fish plates bolted to each section with mushroom head galvanised steel roofing bolts.

Where cuts have been made, the tray shall be painted with zinc rich paint. Holes that have been cut to allow cables to pass through shall be suitably bushed.

Suspension sets shall comprise threaded M12 cadmium plated hanger rods together with nuts and locking washers, vertical hanger brackets, support channel, tray hold down clips etc. and all of which shall have a galvanised finish.

All cables shall be securely fixed to tray work and the complete installation shall be carried out in a neat and workmanlike manner without crossovers

Cables of 30mm diameter and above shall be fixed using the appropriate size cable cleat as manufactured by AEI Ltd or equal and approved.

On multi light-duty cable runs, cable straps of plastic coated metal shall be used to secure cables.

Cables shall be clipped by means of copper or brass saddles and clips where high temperature or humid conditions are likely to be experienced. In all cases, saddles, clips, straps etc. shall be fixed to the tray by means of brass screws or bolts and nuts.

Every cable tray length shall be bonded in its entirety by 12mm x 1.5mm copper links bolted across each joint by means of M6 brass nuts and bolts complete with spring washers.

Every cable tray length shall be fitted with inverted cable tray through, and extending to 300mm either side, of fire barriers.

Every cable tray length shall be externally wrapped with mineral wool with wire mesh reinforcing over the whole length within the fire barrier and extending to 300mm either side.

Every cable tray length shall be painted to BS 5493 where cuts have been made and shall be suitably bushed where holes have been cut to allow cables to pass through.

2.10.5 Steel Conduit Systems

Conduits shall be installed as required by IET Wiring Regulations and as detailed in the specification.

All metal conduits must be heavy gauge, seam welded, steel tube screwed conduits manufactured to BS EN 61386-1.

Conduits shall either be finished black stove enamelled, except in positions exposed to water, steam condensation or the action of weather, where hot dipped galvanised conduits shall be used. Refer also to the requirements of the Particular Specification.

Any conduit work rejected by the Engineer due to poor manufacture, poor installation, damage or inappropriate finish shall be replaced by the Contractor at no extra cost.

Conduits shall not be used to provide the protective conductor. All conduits shall be equipotentially bonded if installed to an insulating medium (for example plastic trunking).

No conduit smaller than 20mm diameter or larger than 32mm diameter shall be used.

The drilling and tapping of non-structural steelwork, the supply and fixing of metal straps, supports, clips, clamps and plates and the introduction of additional conduits of larger sizes than actually required for wiring, together with all fixing devices, must be included for wherever such practices are necessary, and particularly when luminaires etc., have to be supported independently of specially suspended ceilings.

The Engineers written approval shall be obtained before any holes are drilled or cut in structural steel or structural concrete.

The conduit installation shall be co-ordinated with the other services to be installed in the building, or buildings, and routes shall be agreed with the Engineer prior to commencing the installation. Conduits shall be installed at least 150mm from, and preferably under, hot water pipes and at least 50mm from other service pipes and cables. Conduits shall be bonded to other services in accordance with the requirements of BS 7671.

Earth continuity tests shall be applied to the system before plastering, screeding or casting of concrete is commenced.

Surface work shall be allowed where certain pre-fabricated methods of constructions preclude the concealment of the runs, and on fair faced brickwork or blockwork or other unplastered walls.

Conduit runs shall be planned to limit the need for draw in boxes to the minimum British Standards requirement, but where the use of such boxes is unavoidable, they shall be accessible at all times and be fitted with covers.

The installation of conduit boxes in floors shall generally be avoided but where it is essential, and agreed with the Engineer, the floor boxes shall be fitted with brass covers recessed to accommodate the floor finish. The covers shall seal the box against the ingress of moisture.

When conduits are specified as being surface mounted, the runs must be arranged to render the whole system as neat and inconspicuous as possible, having regard to existing architectural features. All vertical and horizontal runs must be plumb and level respectively.

Particular care must be taken where conduits converge and run together near switchgear to obtain a symmetrical layout. The distance between conduits shall be maintained through bends and sets and shall not noticeably vary.

All conduit runs must be designed to permit wiring to be readily installed after the complete erection of the conduits through the available draw-in, accessory and/or luminaire suspension boxes.

No conduit runs shall be allowed to be laid underground in any circumstances whatsoever.

In all positions where the appearance of the conduit layout would be improved by the introduction of dummy lengths of conduit and in all cases where a more secure fixing for the suspension fittings is considered necessary and would be obtained by continuing the conduits from their respective normal terminations, such dummy conduits and continuations must be included for and installed.

Conduits shall be stored in dry conditions prior to installation. All conduits damaged mechanically, or by oxidation, shall be rejected. The manufacturers threads applied to each length of conduit shall be cleaned by means of conduit thread die before installation.

Conduit fittings shall have the same finish as the conduits being used and shall comply with BS EN 61386. All conduit fittings shall be screwed or ‘loop-in' malleable iron circular type fitted with covers secured by brass screws. Rectangular adaptable steel boxes may be used on multi conduit runs.

All circular type boxes must be fitted with long screwed spout conduit entries with the screwed thread terminating within the spout and the edges of the internal orifice of the box rounded and smoothed to act as a bush, except the adaptable steel rectangular boxes and loop in conduit boxes, in which case a bush and coupling must be used for conduit connections.

In concealed installations, boxes shall be fixed with the rims flush with the finished surfaces. Suitable extension rings of the required depth shall be provided and installed as necessary to finish flush with the surrounding surfaces and with lids of sufficient oversize (7.5mm minimum all round), to cover the junction between box and plaster.

The use of site-manufactured bend, sets, elbows, inspection elbows or tees shall not be permitted.

All conduits must be firmly and rigidly fixed and be entirely without whip or movement. Spacer bar saddles, or straps saddles, must be used on the timbers in roof spaces and shall be allowed for when conduits are run on the underside of exposed unsealed floors or ceiling joists.

Pipe hooks or crampets shall not be allowed, except for securing conduits in chases or screeds, when the top of the hook must be at least 10mm below the finished surfaces of the walls or 25mm below the floor finish. Pipe hooks shall be galvanised.

The standard cast iron distance saddle, (single fixing base and two screw fixing top) must be used for all conduits run on the surface of walls and ceilings etc. and throughout the building, fixed at intervals of not more than 1.2 metres.

Where the conduit system is the sole support of the luminaires via boxes, additional saddles disposed symmetrically about and near to the point of suspension must be introduced for security of fixing.

When fixings into the wooden parts of the fabric (i.e. joists etc.) are not available or are not permitted metal plugs must be fitted to fully accommodate fixing screws or minimum length 35mm. All fixings shall be effective and shall be capable of supporting the loads imposed by the installation.

The finish of the saddles must, in all cases, conform to the finish of the supported conduits. Galvanised, sheradised or cadmium plated screws shall be used in all cases where galvanised conduit is installed.

Where surface mounted equipment, other than luminaires, is specified all concealed conduits shall be terminated and an adaptable box installed recessed into the wall at every surface mounted equipment position.

All conduit ends must be filed square and reamed before erection to ensure freedom from internal burrs and roughness.

Running couplings shall only be used on black enamelled steel conduit installations, and the use shall be kept to the minimum. All running couplings shall be secured by means of lock nuts or lock rings, and the exposed thread painted after installation.

Every conduit connection to equipment, boxes, distribution boards, loop-in boxes, cable trunking etc. shall be made by means of a screwed coupling, serrated washer and male hexagonal headed smooth bore brass bush.

The smooth bore brass bush shall be fitted to secure the conduit to the item connected via a purpose made clear hole only sufficiently large to permit the bush to be rotated. The hole shall be closed by the bush, serrated washer and coupling when fitted.

Paint must be removed from the surface of the item connected to allow it to be covered by the end of the coupling, which shall be filed, clean and square, to ensure a good mechanical and electrical metal to metal joint. Any exposed area of metal from which paint has been removed must be made good in a matching paint.

Bushes shall be fitted and tightened by means of correctly fitting spanners. Mutilated bushes must be removed and replaced.

Conduits connecting to couplings shall be connected by means of a 15mm long threaded section and shall have a gap of approximately 2mm. No threads shall be exposed except at running couplings.

The whole of the conduit installation shall be mechanically and electrically sound and continuous throughout their length in accordance with BS 7671.

Separate circuit protective conductors shall be provided for each circuit.

All exposed threads shall be painted and all conduit, which has suffered minor damage to its paint, shall be made good to prevent oxidisation.

Lubricant or cutting compound shall be removed from conduit prior to painting. Galvanised conduit, which is slightly damaged, shall be primed and painted with a zinc based paint to match the colour finish of the conduit.

Conduits, which are more than slightly damaged, shall be rejected.

All conduits, which are to be painted as part of the interior decoration, shall be painted by the Contractor.

2.10.6 PVC Conduit Systems

PVC conduits shall be heavy gauge, high impact manufactured to comply with BS EN 50086. All conduit boxes, couplings, draw-in boxes etc. shall be of the same manufacture and quality as the conduit.

No elbows, tees or inspection bends shall be permitted.

During the course of the installation of the conduit system, procedures for working and dressing the installation as recommended by the manufacturer shall be employed.

All bends and sets shall be in accordance with BS 7671 formed with the aid of a helical spring fitted internally, with the conduit warmed sufficiently for it to move without deformation of the bore, and without avoidable wall thinning on the outside of the bend.

Surface conduits shall be supported by spacer bar saddles fixed at a maximum of 1 metre intervals, except for bends where saddles shall be positioned 200mm either side of the bend. Conduits shall be free to slide within the saddles.

All saddles, conduit and boxes must be in perfect alignment, to prevent warping when the installation is complete. Concealed conduits shall be fixed by galvanised crampets. The top of the crampets must be at least 10mm below the finished surface in walls and 25mm below the finished surface in floors.

Expansion couplings shall be installed where any length of conduit, inclusive of draw-in boxes etc. exceed 5 metres in length.

Where insulated conduit sections and fittings or accessories are required to be jointed, the manufacturer's proprietary jointing cement shall be used. The manufacturer's recommendations must be adhered to with regard to jointing procedures.

Where expansion joints occur, these shall be made with the manufacturer's watertight expansion jointing cement to ensure adequate movement of the system during temperature changes.

Throughout the entire system of an insulated conduit scheme an LSZH insulated green and yellow coloured protective conductor shall be installed in accordance with BS 7671.

Cable capacities stated in BS 7671 shall include the separate circuit protective conductor.

2.10.7 Flexible Conduit Systems

Flexible conduit shall comply with the BS EN 61386-23 and shall be used for the final connection from a rigid conduit installation to the terminal boxes of all equipment provided with a means of positional adjustment and/or where vibration may reasonably be expected to occur.

In normal circumstances, flexible conduit shall have a minimum length of 300mm and a maximum unstretched length of 800mm. It shall permit a full range of withdrawal, adjustment or movement of the equipment.

Flexible conduit shall be LSZH sheathed, unless specified in the Particular Specification, and shall be terminated using approved glands.

In all instances, a separate LSZH insulated green and yellow coloured circuit protective conductor complying with BS 7671 shall be installed at each end, terminated into purpose made earthing terminals.

Under no circumstances shall flexible conduit be accepted in lieu of sets and bends in rigid conduit installation.

2.11 Wiring Systems

All cabling supplied under this contract shall be manufactured by a British Approvals Service for Cables (BASEC) approved manufacturer.

2.11.1 Conduit and Trunking Wiring Systems

All cables shall have Low Smoke Zero Halogen (LSZH) insulation compliant with BS 7211, BS EN 50525-3-41 and BS EN 60754.

The quality and size of cables contained in any one conduit or trunking shall comply with BS 7671.

No cable with a cross-sectional area of less than 1.5mm^2 shall be used. All cables installed in a conduit or trunking system shall be LSZH insulated conductors and shall be colour coded in accordance with BS 7671.

Final circuits shall be installed in conduits separate from main or sub-main cables. All cables in a conduit shall be installed simultaneously to prevent damage to the cable insulation.

Where cables are installed in cable trunking, the space factor shall be 40% and a further spare capacity of 10% shall be included for future wiring after the completion of the installation.

All cables shall be installed without the use of excessive force or lubricants and the wiring shall be easily withdrawable.

Cables shall not pass through luminaires unless the luminaires are specifically designed with a wiring way protecting the cables from mechanical damage and/or heat.

The wiring of the installation must be in strict accordance with the drawings, cable sizes and circuit details provided in the specification and schedules or drawings, issued for the particular project.

All wiring of multipoint sub-circuits must be carried out utilising the loop in system and no joints or connectors other than those required for the connection of luminaires, and other equipment detailed in the Particular Specification, shall be allowed.

On all AC supplies, care must be taken to ensure that both live and neutral conductors are contained in the same conduit/trunking.

The minimum length of spare cable generally to be left at each accessory shall be 150mm per conductor to enable terminations to be remade.

Cables must be terminated by one of the following methods:-

- The cable conductors shall be sweated into lugs of the appropriate size for the cable and equipment terminal.
- The cable conductors shall be secured by compression type lugs of the correct size for the cable and equipment terminal.
- The cable conductors shall be secured by means of clamps.

Where cables are required to terminate at luminaires and other heat generating equipment, the connectors shall be insulated with porcelain or an approved heat resistant thermosetting material such as melamine capable of withstanding, without detriment, the temperature encountered.

The cross-sectional area of cable conductors shall not be reduced at terminations and connections shall secure all the strands of stranded cables. Care shall be taken to ensure that cables are not damaged during preparation for termination.

2.11.2 XLPE Insulated, Steel Wire Armoured and LSZH Sheathed Cables

Cables shall be manufactured to BS 6724, with conductor dimensions and resistances in accordance with BS EN 60228. Galvanised armour wires shall be in accordance with BS EN 10257-1.

XLPE/SWA/LSZH cables shall be insulated with cross-linked polyethylene (XLPE) in accordance with BS 6724. Generally, XLPE/SWA/LSZH cables shall be employed unless detailed otherwise in the Particular Specification.

Where the armour wires of cables are used to provide the protective conductor they shall comply with the requirements of BS 7671. Alternatively, the Contractor shall install additional cables with copper conductors to reduce the impedance to a level which ensures compliance with BS 7671.

Unless permission is given by the Engineer, or detailed in the Particular Specification, no joints shall be allowed.

In the event of joints being authorised they shall be made using polycarbonate boxes of approved design filled with an approved cold pouring plastic or resin compound. The cable box shall incorporate suitable copper tapes and clamps to bond the armouring of the jointed cables.

Compression joints shall be made with the correct size tool and pressure for the ferrules used, or have soldered joints using solder of grade "M" or grade "C" complying with the requirements of ISO 9453.

All cables shall be terminated in the cable manufacturers approved glands. These shall be of the compression type providing controlled radial compression of the sheath seal.

The gland shall incorporate an armour-clamping ring and earthing ring, and where used outdoors, a weatherproof washer shall be used to ensure a watertight joint between the gland and the unit to which it is fitted.

The earthing ring shall be rigidly fixed to the item of equipment and terminated using brass nuts, bolts and washers.

All gland terminations shall be protected by a LSZH shroud which shall fit tightly over the cable.

All cables shall have the cores connected to bolted connections in bus-bars etc. and by means of compression type terminations, made off by means of hydraulic compression tools and suitable die to suit size of cable.

Each terminal shall be fitted with a brass washer between the socket and securing nut or bolt to ensure good electrical contact.

Where cables having aluminium conductors are specified, aluminium/copper bi-metal socket and pin type terminations shall be used.

Cable bends shall be in accordance with manufacturer's details and BS 7671.

The Contractor is responsible for determining the true nature and extent of cable routes. No claim on the grounds of lack of knowledge shall be accepted. All cable routes shall be agreed with the Engineer.

After the cables have been installed and terminated, and prior to putting into service, they shall be subjected to an insulation test of 500 Volts and the results of these tests (recorded on test sheets) forwarded to the Engineer.

2.11.3 XLPE Insulated and LSZH Sheathed Twin and Earth Cables

XLPE/LSZH insulated and sheathed cables shall have copper conductors and shall comply with BS7211, BS EN 61034 and BS EN 50267-2-1 and shall be 300V/500V grade unless detailed otherwise in the Performance Specification. The cores shall be coloured in accordance with BS 7671.

Generally, XLPE/LSZH cables shall be run in ceiling and floor spaces and in round heavy-duty high impact PVC conduits in walls.

Where cables are to be installed flush within a wall or ceiling within 50mm of the surface they shall be either protected by a 30mA RCBO or enclosed in earthed steel conduit.

Wiring shall be carried out utilising the loop-in principle. No joints shall be allowed unless prior agreement has been received from the Engineer. In the event that joint boxes are installed following agreement with the Engineer, they shall be installed in locations that are fully accessible after completion of the building.

No joints shall be allowed in protective conductors except at items of fixed equipment, socket outlets or other accessories, where loops are formed.

The cables shall be installed to give maximum rewireability, commensurate with the specified method of installation.

Cables installed in ceiling spaces shall be accessible through removable ceiling tiles or ceiling access panels and shall not be imbedded in the building fabric.

Cables in ceilings shall be run parallel or at right angles to main secondary beams or joints etc. and no diagonal runs shall be permitted.

All cables in suspended ceiling areas shall be installed into purpose made cabling baskets or wiring stirrups which shall consist of adjustable 'P' clips as manufactured by Critchley Ltd or equal and approved.

The `P' clip shall be formed into a 75mm diameter loop with fixings to the ceiling soffit. In order to afford a withdrawable facility, not more than four circuits shall be supported within the confines of one run of clips.

Cables shall be free to move in supporting clips and shall only be secured at terminations.

The clips shall be fixed at intervals not greater than 450mm and at 200mm each side of a bend or other change in direction. A clip shall be fixed at 200mm each side of a lighting point to support the cables serving the lighting point and wherever cables drop to leave the suspended ceiling area.

XLPE/LSZH cables shall not share a common run of clips with any other type of cable. Where cables cross pipe or duct runs, the cables shall be supported beneath the pipe or ducts.

An adequate distance shall be provided between cabling and pipe or ductwork to allow the installation of suitably sized insulation, and to prevent heat damage to cabling by heat emission from heating pipework.

Where the cables pass through floors, or may be subject to damage or abuse, they shall be protected up to a height of 1200mm by heavy gauge conduit suitably bushed. In certain instances, and where indicated by the Engineer, the cable shall be protected up to a height of 1200mm by plastic capping or oval conduit.

Cable entry into accessory boxes shall be via grommetted holes.

The internal radius of cable bends shall be not less than those set out in BS 7671.

Cables run on fair faced brickwork shall be protected by means of heavy-duty high impact PVC conduit securely connected to the accessory box.

Where cables converge and are routed into distribution boards they shall be installed within steel trunking flanged into the distribution board.

The cable entries to the distribution board shall be grommetted. The trunking shall be suitably sized with reference to the grouping of cables and derating factor of grouped cables.

All XLPE/LSZH cable terminations shall be made to ensure that 150mm of spare cable remains in each conductor at each accessory. In distribution boards, conductors shall be sufficiently long to enable them to be connected to any circuit in any phase.

All protective conductors shall be sheathed with green and yellow sleeving at terminations.

Cables to lighting points shall terminate at bushed steel conduit boxes to BS EN 61386-1 securely fixed in the ceiling. Cables shall enter via male brass bushed entries and an earthing terminal shall be provided in each box. Cable conductors shall terminate at isolated brass tunnel connectors.

At recessed luminaires, sub-circuit wiring shall terminate at a rigid BESA type box located adjacent to the luminaire. A plug in ceiling rose shall be installed and final connection shall be made using multi-core high temperature flexible cord.

Final connections to LED luminaires, fluorescent luminaires or batten lamp holders shall be made by means of 1.0mm² heat resistant flexible cables of the same cross-sectional area as the final sub-circuit cables. Final circuit wiring at pendant lighting points shall be directly connected to the ceiling rose.

Where the internal operating temperature of a luminaire is such that high temperature cable of a specialist type is required, this shall be installed in every instance.

Where cables are run under floors and in roof spaces, they shall be passed through holes drilled in the neutral axis of the joists where possible, but in no case shall the holes be less than 50mm from the top or bottom surface of any joist.

All runs shall be made straight, both parallel with and at right angles to the sides of the building. All risers and drops shall be vertical.

2.11.4 Flexible Cords and Cables

All flexible cables and cords shall be of low smoke zero halogen materials to BS EN 50525-3-11. They shall be multi core circular flexible cables or cords being insulated and sheathed and shall be colour

coded in accordance with BS 7671, rated in accordance with the equipment they serve and shall be suitable for the operating temperature envisaged.

In heat resisting conditions, flexible cables and cords shall be silicon rubber to VDE 0295 and IEC 60332-1-2. They shall be multi core circular flexible cables or cords being insulated and sheathed and shall be colour coded in accordance with BS 7671, rated in accordance with the equipment they serve and shall be suitable for the operating temperature envisaged.

2.11.5 Soft Skin Fire Rated Cables

Fire resisting cables shall be 300/500V rated enhanced grade PH120 softskin cable in accordance with BS 5839-1 and shall have copper conductors and red LSZH sheath, as AEI Firetec or equal and approved. Wiring shall be carried out using a minimum of 1.5 mm² conductors.

All fire resisting cable runs shall be approved on site by the Engineer before the commencement of the installation of the cables

Cables shall be manufactured and approved to BS 7629 and certified by British Approvals Service for Cables (BASEC).

Cables shall comply with the following fire performance standards:

a) Resistance to fire IEC331, BS 6387 category CWZ
b) Smoke emission IEC1034, BS 7622
c) Acid gas emissions IEC754-1, BS 6425-1 (less than 0.5% acid gas)
d) Flame retardant IEC332-1, BS 4066-1
e) Reduced flame propagation IEC332-3 cat c, BS 4066-3 category C
f) Cables shall be manufactured under an ISO 9001 Quality System certified by BASEC.

All materials within the cable and associated accessories shall be Low Smoke Zero Halogen (LSZH) in performance as assured by the tests.

Insulation shall be high performance damage resistant.

Where cables are fixed direct to the building fabric, purpose designed coloured LSZH coated ‘P’ clips with the same fire rating as the cable, must be used to ensure the fire survival properties of the installation.

In addition to the above, purpose designed manufacturers LSZH cable glands shall be used.

The cable should be clipped as per the recommendations of BS 7671.

Cable joints are not permitted.

Cable support systems should also be able to withstand the same temperature as the specified cable.

This requirement has the effect of precluding the use of plastic cable ties, trunking and cable clips where these items form the sole means of support. Plastic trunking may be used as a means of mechanical protection, however, cable should be fixed inside the trunking in accordance with the above information.

Segregation of differing voltage bands and communication/data cabling must be maintained at all times.

Where cables pass through walls, floors, etc. they shall have the holes filled with a fire resisting intumescent material installed to prevent the spread of smoke and fire.

All cables shall be routed on galvanised cable basket above suspended ceilings where available and shall drop within flush galvanised conduit mechanically connected to the galvanised basket down to the new equipment.

All cables that are not installed above suspended ceilings shall either be installed in white PVC trunking with all metal fixings to the building fabric, secured to the building fabric at a minimum spacing of 300mm

using metal P clips or within all round LSZH coated metal banding with a minimum segregation distance of 50mm from other voltage band cabling and secured.

All manual call points, fire detection devices, fire alarm sounders and visual alarms shall be looped together and on no account should there be any spurs or tees. Wiring shall be carried out in full accordance with the manufacturer's recommendations.

Where fire-resisting cables are routed underground, they shall be LSZH sheathed, buried at a depth of not less than 600mm below finished ground level, bedded on 50mm of soft sand, covered with 50mm of soft sand and protected with cable warning tiles.

When specifically detailed PVC warning tape shall be used in lieu of tiles, but shall be laid 150mm below the finished ground level. The Contractor shall include for the supply and installation of approved type concrete cable route marker posts with plate indicating depth of cable.

Trenches, cables and protection must be inspected by the Engineer prior to backfilling. In the event of this not being complied with, the Contractor shall be required to re-excavate at his own expense to demonstrate satisfactory installation.

Where cables pass through walls, floors or the foundations of buildings, they shall be suitably protected by sleeves. All rising cables shall be protected up to a minimum height of 1800mm or extended above this height where required to improve the appearance of the complete installation.

Any bend in the cable shall have an inside radius of not less than six times the overall diameter of the cable.

The spacing of saddles or clips shall not exceed the dimensions indications below:

Horizontal runs 450mm
Vertical runs 750mm

All cable terminations shall be of an approved pattern and applied in the manner recommended by the manufacturer of the cable.

Shrouds shall be fitted to all terminations when the cable is LSZH covered. All terminations must be tested for insulation resistance and infinity readings only shall be accepted.

No through joints shall be permitted in any cable.

Individual single core cables shall not pass through ferrous metal at any point.

At each end of an underground cable, a metal label stamped with the size, number of cores and position of other end shall be securely fixed, adjacent to the termination point.

2.12 Protection of Supporting Steelwork

All supporting steelwork shall be free of rust and treated with an approved rust inhibiting compound prior to installation.

The steelwork shall be painted with a minimum of two coats of red oxide paint prior to installation and finally painted with the appropriate undercoat and topcoat to match the associated equipment after installation.

2.13 Buried Services

All LV and ELV cables which are required to be buried below ground level outside the premises shall be laid at the following depths:-

a) A minimum of 600mm below finished ground level in footpaths and soft dig areas.

b) A minimum of 750mm below finished road level when installed under roads, car parks and concrete areas.

Cables installed under roads, through foundations, through walls or under concreted or tarmac areas shall be enclosed in twin wall PVC rigiducts. The diameter of the ducts shall generally be 100mm unless detailed otherwise in the Particular Specification.

Where possible the under road crossing shall be installed at right angles to the roadway. The top of the highest duct shall be a minimum depth of 750mm below the roadway surface and shall be surrounded by 150mm radial thickness of concrete.

Where ducts are installed under roadways, concreted or tarmac areas, a minimum of one spare duct shall be installed. A draw wire shall be installed within each duct. Duct ends shall be fitted with bungs for the prevention of the ingress of dirt, grit, water and vermin.

Ducts and cables shall be laid on a 50mm layer of soft sand with a further 50mm layer of soft sand above the duct or cable. Interlocking PVC cable markers shall be installed 150mm above the duct or cable and the excavation shall be backfilled to ground level utilising soil. Cable tiles shall be at least 50mm wider than the space occupied by the installed cables. The Contractor shall allow for reinstating the ground to the surrounding finish.

Route indicating blocks shall be set into the ground directly above buried cables and ducts. The blocks shall have the words “ELECTRICITY CABLES” with an indication of the direction of the cable. The top face of each block shall be level with the surrounding ground or finished level. The blocks shall be placed at changes in direction and at intervals of 50 metres.

A plate shall be fixed to walls 300mm above ground or floor level where cables pass from ground into building. The plate shall have the words "ELECTRICITY CABLES" in 20mm lettering.

2.14 Cabling External to Buildings

Care shall be taken to ensure that all cable is installed without being twisted or kinked. Damaged cable will be rejected and must be replaced at the Contractors expense.

The cable shall be delivered to site with its end effectively sealed and any cables cut on site shall have their ends immediately and effectively sealed with a cap, which shall permit movement of the cores during installation without impairing the seal.

Cables installed on building surfaces shall be secured by means of correctly sized silicone aluminium claw or clamp fixing cleats, claw cleats for smaller cables, cleats for the larger cables.

Multiple cable runs shall be planned and installed in such a way that crossovers are eliminated. The design of multi-way cable support racks shall be submitted to the Engineer for approval before manufacture.

Spacing between cables shall be in accordance with BS 7671.

The Contractor shall take all reasonable precautions to ensure that the cables are not subjected to heating from adjacent service lines, heater units or plant operating at high temperatures.

When the routing of cables is not indicated on a drawing or described in the Particular Specification, the Contractor shall submit details of his proposed routing to the Engineer for approval prior to commencing the installation.

The Contractor shall supply and install all steelwork and other support structures required for the support and effective installation of the cables.

Where more than three cables are surface mounted along the same route, then they shall be installed onto a heavy gauge cable tray of the perforated type, fixed at regular intervals to ensure that no bending or buckling occurs.

On no account shall cables be stacked except where single core cables are specified as being in "trefoil" formation.

Cables supported on steelwork shall be fixed by approved steel straps. The minimum bending radius of the cables shall be as stated in BS 7671. All cable bends shall be adequately supported.

Special care shall be exercised in supporting cable at terminations to ensure that undue strain is not placed on any part of a cable termination or equipment.

Cables shall be installed as neatly as possible and shall be protected from mechanical damage to a height of 2.0 metres above finished floor level by means of galvanised steel channel manufactured from steel of at least 2.0mm thickness designed to span a cable or group of cables and fixings.

Cable entry into a building from the ground shall be by means of twin wall PVC rigiducts adequately sized to permit installation without undue strain being placed on the cable during installation.

All ducts shall be effectively sealed to protect the ingress of moisture, vermin etc.

Where low temperatures are present during installation of cables, the cables must be stored at a temperature above 5°C for a minimum of 24 hours before installation commences.

2.15 Methods of Fixing

2.15.1 General

The Contractor shall ensure that every fixing installed is adequate to support and/or restrain the item of plant.

2.15.2 Accessories and Lightweight Equipment

Lightweight equipment, accessories and conduit saddles shall be fixed to brick or concrete structures by means of sheradised screws in white metal or bronze plugs.

Round head screws shall be used where fixings occur inside accessory boxes.

Fixings to brick and blockwork shall be made in the bricks and not in the seams. Fixing to enclosed hollow structures of soft or hard fibreboards etc. shall be made using proprietary spring or gravity toggles or equal and approved.

Under no circumstances shall such fixing methods be used in plasterboard, or materials of a like nature. Fixing to timber shall be made using steel wood screws.

Where fixings occur in a damp or humid atmosphere or are exposed to the weather, galvanised steel, brass or cadmium plated steel screws shall be used.

Lightweight equipment installed on a mild steel sheet structure shall be fixed by an appropriately sized setscrew and must be complete with plain and serrated or spring washer.

Screws with damaged threads and/or damaged heads shall be replaced by the Contractor.

2.15.3 Heavyweight Equipment

Fixings to brick and concrete shall be made using an approved expanding bolt suitably sized and entered into a pre-drilled hole of depth (exceeding plaster thickness) equal to the length of fixing to be used.

The threaded section of an installed expanding bolt fixing shall protrude through the equipment fixed, to enable a nut, plain and serrated or spring washer to be fixed leaving a minimum of 4mm thread exposed.

Fixings to brickwork shall be made in the bricks and not in the seams.

Fixings may be achieved in concrete structures by pre-casting or grouping rag bolts.

Fixing of heavy equipment to metal framework and other substantial structures shall be made using steel setscrews or bolts with nuts, plain and serrated or spring washers.

Heavy equipment shall not be fixed by plugs or shot bolts without written approval of the Engineer, nor shall any structural steelwork or support be drilled or cut without this approval.

In all cases where fixings, bracketwork and other metal supports are exposed to the weather, they shall be suitably treated with an inhibiting substance.

Fixing adaptors, bracket or patented approved fixings to steelwork shall be manufactured from mild steel and be a minimum of 4mm.

2.16 Accessory Mounting Heights

The approximate position of main switchgear, control equipment, distribution boards, fittings and accessories shall be as indicated on the drawings. Actual positions shall be determined on site by the Contractor before the work commences.

The right is reserved, prior to the work commencing, to make minor alterations to accessory positions of up to two metres in either direction, without incurring any cost variation to the Contract.

All items of equipment shall be mounted at the following heights above floor level unless stated otherwise. Mounting heights and positions shall be in accordance with BS 8300. All general mounting heights indicated are to be confirmed on site with the Align Property Partners prior to installation.

Fire Alarm Control Panel	1500mm to the centreline
Intruder Alarm Control Panels	1500mm to the centreline
Manual Call Points	1100mm to 1160mm to centreline
Bells, Sounders and Beacons	2200mm to 2400mm to centreline
Mechanical Controls	As instructed by the Mechanical Contractor
Isolators	1400mm to centreline
Interfaces	To suit interfaced equipment
Switches	1160mm to centreline
Fused Connection Units,	450mm to underside (LL) 180mm above work surfaces to underside (WS) 2200mm to 2400mm to centreline or as specified (HL)
Socket Outlets and Accessories	450mm to underside (LL) 180mm above work surfaces to underside (WS) 2200mm to 2400mm to centreline or as specified (HL)
Dado trunking	Co-ordinated with desk height, window sill and radiator levels. Height to be agreed on site
Distribution Boards	1400mm to the underside
Others	To be agreed on site

All accessories are to be co-ordinated and centred within wall panels and tiled areas to present a symmetrical detail within the wall panel or tile.

All measurements are generally to centre of the item. Points are to be located as near as possible to positions shown on the drawings, but may require a slight modification to suit site conditions. The location of all electrical items indicated on the drawings are diagrammatic only and the Contractor shall allow within their costings to relocate all electrical items up to a 2000mm radius. The Contractor shall agree the final positions of all points with the Engineer on site prior to any installation work being carried out.

2.17 Labelling and Engraving

2.17.1 Labelling

All fused switch units, switch fuses, switches, bus-bar chambers, distribution boards, consumer units etc., and all items of equipment on main switchgear shall be identified in accordance with Section 514 of BS 7671 and shall have securely fitted externally a traffolyte label engraved with 6mm high black letters detailing the function of the equipment, any reference numbers and the size of incoming and outgoing cables and types.

Each main switchboard, section board and distribution board identification label shall also include the measured prospective short circuit and earth loop impedance value, including date of measurement.

Each section board and distribution board shall be fitted internally with a type written list giving details of all protective device ratings, supply phase, equipment served and size and type of all circuit conductors, fault level and earth fault loop impedance.

Each list shall be mounted in an envelope formed from 0.5mm thick clear non-inflammable material.

The envelope shall be open at one end and fitted to the inside of the distribution board with 5mm diameter rivets passing through eyelets in the envelopes.

An additional typed copy of each circuit chart shall be incorporated in the Operation and Maintenance manuals and handed to the Engineer.

Each TP or TPN item of switchgear shall have fitted on the cover a yellow traffolyte label stating "CAUTION - 400 VOLTS" engraved in 10mm high black lettering.

2.17.2 Engraving

The Contractor shall allow for engraving of all fused connection units, double pole switch accessories and other accessories which are required under this specification.

The accessory plate shall be engraving in either black or red, capital letters 5mm high detailing the appliance or equipment being supplied by the accessory and the circuit reference e.g. "EXTRACT FAN – DB1/1L1", "WATER HEATER – DB2/2L1", "EXTERNAL LIGHTING – DB3/3L1" etc.

2.18 Building Expansion Joints

Routes of electrical services, cables, conduit, trunking and cable trays etc. shall be designed to avoid crossing building expansion joints if at all possible.

Under no circumstances shall conduits and cables encased in the building fabric or floor screeds etc., be allowed to cross a building expansion joint.

Where it is unavoidable for surface cables and support systems to cross an expansion joint, the following precautions shall be taken:-

a) A sufficient loop of cable must be allowed between fixings on cables fixed directly to the building.

b) All conduits in air must be joined by a 150mm minimum length of flexible conduit, linking conduit and adaptable boxes and be suitably looped to accommodate the maximum variation in the building structure. A minimum protective conductor of 4.0mm^2 shall link the conduit section.

c) All cable trunking crossing an expansion joint shall be linked by flexible trunking connections, the flexible section being a minimum of 250mm in length or greater to

accept the maximum building variation. The two fixed sections of trunking shall be linked with a 25mm flexible braided copper earth tape.

2.19 Termination at Fixed Equipment

2.19.1 Apparatus Served from Surface Mounted Final Control Equipment

In a conduit installation where the final control equipment is remotely located from the electrical apparatus being served, a conduit link shall be installed from the control equipment to terminate adjacent to the apparatus in a fixed through conduit box complete with lid.

Flexible conduit shall connect the conduit box with the apparatus in accordance with the correct method of earthing as required by BS 7671.

Cables serving the electrical apparatus shall be continuous throughout their length, passing unbroken through the conduit box and flexible conduit.

Connectors fitted inside the conduit box shall not be permitted unless agreed with the Engineer.

2.19.2 Apparatus Served from Flush Mounted Final Control Equipment

A conduit recessed into the building fabric shall link the final flush mounted control equipment to a conduit termination box recessed adjacent to the apparatus.

An extension box with conduit spout outlet shall be fixed to the terminal box using the fixing lugs provided, a break joint ring being fitted between the two.

The screws securing the extension box shall not form part of the earth path, a separate earth being obtained from the recessed conduit box.

Flexible conduit shall connect the recessed conduit box with the apparatus in accordance with the correct method of earthing as required by BS 7671.

Cables serving the electrical apparatus shall be continuous throughout their length, passing unbroken through the conduit box and flexible conduit.

Connectors fitted inside the conduit box shall not be permitted unless agreed with the Engineer.

2.19.3 Insulated and Sheathed Cable Installations

Where insulated and sheathed multicore cables are used to serve an item of electrical apparatus they shall terminate adjacent to the apparatus in a suitable connection unit and/or isolating switch as specified.

Final connections shall be made using an insulated and sheathed multicore flexible cable or cord restrained at each end by either cord grips forming part of the connection unit and apparatus or approved packing glands correctly sized to the flexible cable or cord used and fixed to the connection unit and apparatus by a coupling and smooth bore or entered directly into the apparatus by a tapped conduit entry if possible.

Final connection to an electric cooker shall be made using a proprietary cooker outlet connection.

2.20 Lighting Installation and Equipment

2.20.1 Luminaires

All luminaires shall be installed in the positions indicated and shall be of the type and size specified on the drawings. They shall be in accordance with BS EN 60598.

The Contractor shall supply and install all luminaires including LEDs, control gear, glassware, diffusers or other attachments, heat resistant internal cables, fuses and terminals and all necessary suspension equipment and accessories.

Unless otherwise stated, luminaires shall be suitable for Class 1 normal indoor environments, giving a degree of protection against ingress, moisture or dust of IP22 and shall be suitable for operation in an ambient temperature of 30°C.

All luminaires shall be assembled and installed in accordance with the respective manufacturer's instructions/recommendations, in the positions and mounting height specified.

Luminaires shall not be installed under dirty and hazardous site conditions, and any damage or deterioration to luminaires installed under these conditions shall be made good by the Contractor.

The Contractor shall allow for any modifications to the standard luminaires required by the specification.

The luminaires shall be cleaned, free of dust and dirt by the Contractor after completion of the installation i.e. the laying of carpets etc. Where dirt, dust, corrosion or other conditions cause imperfections in the luminaires, they shall be replaced.

Luminaires, diffusers, attachments or glassware etc., shall be properly stored prior to final erection, in such a manner as to avoid damage of any kind.

Luminaire fixings shall generally be suitable for direct connection to conduit boxes or as otherwise specified. Luminaires not provided with suitable BESA box fittings shall be modified as necessary.

Where a flexible cord supports, or partly supports a luminaire, the maximum mass supported by the cord shall not exceed the values set out in BS 7671.

Exterior luminaires, fixed to the walls of the buildings etc., shall be wired such that final circuit wiring terminates within the luminaires.

All final circuit cables so installed shall be provided with heat resistant sleeves from the connection point within the luminaires for a minimum distance of 300mm.

All luminaires mounted on or within suspended ceilings shall be connected by three core 0.75mm^2 high temperature flexible cord from the terminals of the luminaires to a plug in ceiling rose fixed and connected within the suspended ceiling immediately above the luminaire.

The ceiling rose shall be accessible via the opening provided in the ceiling.

The Contractor shall ensure that the methods of suspension for luminaires are electrically and mechanically sound.

Luminaires suspended by means of tubes shall be fitted to ball joints allowing a swing of at least 20˚ all round. Reliable earthing between the fixed and moving parts shall be provided by means of a flexible braided copper tape.

Luminaires shall be provided with a minimum of two fixings, except in the case of recessed modular luminaires or surface mounted luminaires exceeding 300mm in width, where four number fixings (one from each corner) shall be provided by means of conduit drops, threaded rods, gripple wires or suspension arms dependent upon then weight of the luminaire..

Normally visible luminaires support shall be conduit. All luminaires shall be solidly mounted with all assembly nuts, bolts and accessories made tight to prevent vibration and noise.

Anti-vibration packing shall be fitted where necessary. Luminaires mounted direct to trunking shall be fixed by means of the manufacturers recommended fixing assemblies.

Unless otherwise stated luminaire supports shall be fixed to the building primary structure. Luminaires may be supported from suspended ceilings provided the ceiling installer is consulted and confirms that the combined weight of the luminaires is well below the tolerances of the ceiling supports or provides extra supports to achieve this condition.

The Contractor shall be responsible for mounting and fixing arrangements.

Where a flush conduit box is required on a suspended ceiling a break joint ring of approved colour shall be provided for all suspension luminaires and luminaires where the batten is insufficient width to completely cover the conduit box and its associated clearance hole in the ceiling.

The metalwork of all luminaires shall be effectively bonded to the earthing system in accordance with BS 7671.

Care shall be taken to ensure that the internal wiring of luminaires and the cable of any fixed wiring system shall not be in contact with high temperature areas in luminaires.

Lighting track shall be of the type, size, finish, number of circuits and manufacture detailed in the Particular Specification or on the drawings and shall comply with the requirements of the relevant section of BS EN 60570.

The positions of luminaires as shown on the drawings are approximate only and exact positions shall be determined after reference to the Architects ceiling layout and/or setting out details and liaison by the Contractor with all other trades.

2.20.2 Ceiling Roses

Surface mounted ceiling roses shall be of the all insulated high impact moulded plastic construction complying with BS 67 and shall be suitable for direct attachment to conduit outlet boxes. Break joint rings shall be provided for use on flush conduit outlet boxes.

All ceiling roses shall be complete with ‘loop in’ fully insulated terminals inaccessible to touch when the ceiling rose cover is removed e.g. for replacement of flexible cords.

Recessed luminaires shall be served with a conduit mounted plug-in ceiling rose to isolate the luminaire located in the ceiling void within 300mm of the luminaire.

2.20.3 External Lighting

External lighting systems shall comprise the lighting points at the positions shown on the drawings and shall include the supply, erection, installation and connection of all lighting columns, bollards, wall and ceiling luminaires and the provision and connection of all control gear together with the excavation, installation, back filling and connection of all necessary cables, ducts and draw pits. All excavation, trenching, backfilling etc., shall be undertaken by the Contractor.

All lighting columns shall be of approved type and manufacture complete with an outreach bracket (where specified), flush fitting door, wooden backboard for mounting the "cut-out" specified and cable slot, all suitable for looping in and out 3No 2 core XLPE/SWA/LSZH cables of the specific size.

Each lighting column/bollard shall be complete with all adaptors, spigots, mounting brackets, luminaires, control gear and light sources, and shall be provided with a base compartment and lockable door.

All columns/bollards shall be fixed in the correct relationship to the footpath kerb (generally 500mm inside the kerb) and the root depth shall be in accordance with the appropriate British Standard and manufacturers recommendations.

The door shall be positioned such that whilst working on the equipment, the operative shall be facing the oncoming traffic.

All connections shall be terminated in an approved manner, and the installation shall be complete and handed over in working order to the full satisfaction of the Engineer.

2.20.4 Lighting Switches

Lighting switches shall be of the type, size and manufacture detailed in the Particular Specification.

Wall and ceiling switches shall comply with BS EN 60669-1. Wall and ceiling switches controlling lighting circuits shall be rated at 20A and be of the slow break, quick make type unless otherwise stated.

All switch assemblies shall comply fully with BS 7671 concerning the earthing of plates and operating bars or toggles. Where the assembly does not provide a direct reliable electrical contact between the cover plate box with effective connection of metal operating bars or toggles then an insulated earthing lead shall be provided solidly connected to the plate and operating bar or toggle and terminating at a fixed earthing terminal in the box. This provision shall be made in all cases where switches are grid mounted, and also where XLPE insulated and LSZH sheathed cables are installed.

All switches for wall or ceiling mounting shall be of specified manufacture complete with steel boxes of the same manufacture. Switches shall be single or multigang, single, 2 way or intermediate, with or without neon indicators as required.

Earthing terminals shall be provided in each switch box. Finish of plates, switches and screws shall be as specified in the Particular Specification or as shown on the drawings.

Where several switches on one phase are installed at one position, a multi-gang box shall be used.

Where switches at any locations are connected to different phases, purpose made phase barriers shall be installed. The phases shall be separated by means of rigidly fixed barriers and the cable for each phase shall be confined to the area enclosed by the barrier for that phase. Switches connected to a particular phase shall have separate cover or covers fitted over each phase. The covers shall be engraved "CAUTION 400 VOLTS". The switch plate of the specified finish shall be fitted over the phase covers to render the switch unit indistinguishable from the switches which are not phase barrier switches.

For flush positions on a plastered wall or internal partition, the switches shall have overlapping plates.

For flush positions where the finish is fair faced brickwork, the wiring shall be installed on the back of the wall and be back entry into the accessories. Each switch in these areas shall be neatly recessed and incorporate an overlapping plate.

For surface mounted positions such as plant rooms, electrical switchroom etc., switches shall be surface mounted having metal front plates of an aluminium finish mounted in matching metal boxes.

All door swings shall be verified prior to commencing the installation on site and wall switches and pull-cord switches shall be positioned adjacent to the closing edge of the door.

Wall switches shall be located 150mm to the edge of the mounting box, from the door architrave.

Pull cord switches shall comprise a 15A capacity quick make slow break switch action mounted on a high impact resistant non hydroscopic moulded base of the semi-recessed type suitable for mounting in a standard 50mm fixing centre circular BESA conduit box.

Semi-recessed units shall be complete with a white break joint ring fitted between the conduit box and the switch unit.

Where pull-cord operated ceiling switches are specified to be used at door positions they shall be located on the ceiling in such a manner that the cord shall hang free approximately 75mm from any wall face and also be clear of the door movement.

2.20.5 Indicator Switches

Indicator switch units shall be of the ratings shown on the drawings and comprise of switch assembly incorporating a red coloured plastic lens housing a neon indicator lamp to show when the switch is in the "ON" position.

Where multiple switches are necessary the cover plate of each indicator switch shall be engraved to show the function of each individual switch.

2.21 Power Installation and Equipment

2.21.1 Switched Fused Connection Unit

All switched fused connection units shall be complete with steel box with earthing terminal.

Switched fused connection units shall be flush or surface mounted, switched or unswitched, with or without neon indicator and flex outlet as specified.

Switched fused connection units shall comply fully with the requirements of BS 7671 concerning the bonding of the protective conductor terminals. All front plates shall be connected to the permanent earthing terminal within the back box by a protective conductor having a minimum cross sectional area of 2.5mm^2 providing an effective, solid connection to the earth continuity conductor of the installation.

Front plates shall be engraved to indicate the equipment served.

Switched fused connection units shall comply with BS 1363-4 and BS 5733 and shall be of the type which does not expose live metal parts when the fuse holder is opened for replacement of the fuse.

Switched fused connection units shall be fitted with a fuse of the correct rating to protect the appliance and wiring served.

2.21.2 Socket Outlets

All socket outlets and plugs shall be supplied and installed in accordance with the manufacture, types, sizes and finish indicated in the Particular Specification.

All socket outlets shall be of the screened shutter type unless otherwise stated. 13A sockets shall comply with BS 1363 and shall be complete with dual earthing terminals for use on circuits with high protective conductor currents.

All socket outlets shall be switched, unless stated otherwise in the Particular Specification or drawings.

All switched socket outlets shall be complete with steel boxes of the same manufacture, complete with earth terminal.

Assemblies shall comply fully with the requirements of BS 7671 concerning the bonding of the protective conductor terminals. All front plates shall be connected to the permanent earthing terminal within the back box by a protective conductor having a minimum cross sectional area of 2.5mm^2 providing an effective, solid connection to the earth continuity conductor of the installation.

Assemblies installed in the boiler house, plant rooms, ducts and where specified shall be of the surface mounted metal clad comprising a socket and switch. Boxes and cover plates shall be galvanised.

2.21.3 Plugs for Socket Outlets

All plugs shall be of the moulded rubber or other resilient material complying with BS 1363 and BS 546.

The plugs shall have internal cord grip. 13A plugs shall be fitted with cartridge fuse links to BS 1362. The fuse rating shall be selected to give protection to the flexible cord or cable connected.

The Contractor shall connect plugs to equipment as detailed in the Particular Specification.

2.21.4 Steel Boxes

All accessory boxes shall be galvanised steel type for a flush installation, manufactured to BS 4662.

All single and double gang boxes shall be securely fixed using a minimum of 2No round head screw fixings and fitted with phase barriers where necessary.

All back boxes shall incorporate an earthing terminal, which shall be bonded to the circuit protective conductor.

2.22 Inspection and Testing

2.22.1 Visual Inspection

A visual inspection shall be carried out in accordance with IET Wiring Regulations Chapter 64.

Reference shall be made to Section 642 of the IET Wiring Regulations, which is a checklist for initial inspection of installations.

2.22.2 Testing

The electrical installations shall be inspected and tested by the Contractor in accordance with Section 643 of BS 7671.

It should be noted that electronic components, including AFDDs, may sustain serious damage as a result of accepted electrical installation test procedures. Conductors and other circuit components shall be tested prior to them being connected to electronic components.

The presence of electronic components shall be noted clearly on the circuit charts and in Operating and Maintenance manuals with an indication that testing procedures may result in damage.

During construction of the works, the Contractor shall undertake all necessary tests to ensure compliance with BS 7671 and the specification.

Where any part of the installation is to be concealed within the building fabric, tests shall be made to ensure that the installation is satisfactory prior to concealment.

Upon completion of the works, the whole installation shall be subjected to the tests, detailed hereafter and every defect shall be noted, corrected and brought to the notice of the Engineer.

All tests shall be witnessed as required by the Engineer to his full satisfaction. The Engineer shall be given at least one week notice in writing of the proposed tests. All tests shall be executed within the contract programme.

All labour and test instruments shall be provided by the Contractor for carrying out the works. The instruments shall be correctly calibrated and certified for the limits of accuracy required and shall be operated by competent persons.

If, in the Engineers opinion, a particular instrument is not suitable then an acceptable alternative shall be provided. The Engineer shall be at liberty to demand the use of any testing instrument or apparatus that he may reasonably consider to be necessary in the execution of the testing.

If, in the event of the installation failing any tests, the Engineer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by him, in attending the repetition of the tests.

The following items, where relevant, shall be tested in the sequence indicated. Standard methods of testing, in respect of some of the following regulations of this section, are given in the IET Wiring Regulations clauses 643.2 to 643.11.

a) Continuity of conductors.
b) Insulation resistance.
c) Protection by SELV, PELV or by electrical separation.
d) Insulation of resistance/impedance of floors and walls.
e) Polarity.
f) Protection by automatic disconnection of the supply.
g) Additional protection.
h) Check of phase sequence.
i) Functional testing.
j) Verification of volt drop.

In the event of any test indicating failure to comply, that test and those preceding, the results of which may have been influenced by the fault indicated, shall be repeated after the fault has been rectified.

2.22.3 Certification

Following the completion of all inspection and testing required by Section 643 of IET Wiring Regulations, the Contractor shall issue an Electrical Installation Certificate to the Engineer.

The Electrical Installation Certificate shall be in the form set out in Appendix 6 of the IET Wiring Regulations. Any defects or omissions revealed by inspection or test shall be made good before a completion certificate is issued.

2.22.4 Manufacturers Test Certificates

Manufacturers certificates of tests at the specified duties held at the manufacturer's works shall be submitted for switchgear, transformers etc., prior to site delivery.

2.22.5 Commissioning

Commissioning shall be carried out by the Contractor to verify the correct operation of the whole installation.

This shall include proving of equipment installed by Specialist Contractors e.g., Public Address Systems, Intruder Alarm Systems, Lightning Protection Installations, Central Monitoring Systems etc. Equipment employing batteries such as emergency lighting, fire alarms etc. shall be subjected to full performance tests including operation for the prescribed time period with battery re-charge accomplished in the specified time.

Equipment fitted with batteries shall be protected to ensure that no damage is sustained by the battery, charger or any other component discharge or recharge of the batteries when operating unattended.

Emergency luminaires, including self-contained luminaires and general luminaires complete with integral or remote battery packs and invertors, shall not be connected to the supply until testing is to be carried out and shall be disconnected from the supply during the period before handover to prevent damage caused by frequent switching of the electrical supply during the final construction period.

Upon completion of all tests and commissioning, three copies of detailed certificates shall be provided by the Contractor to identify that the equipment, materials, installations etc., have been tested and commissioned as detailed above.

One copy of each duly completed and signed commissioning certificates shall be submitted to the Architect within 14 days of the results being obtained. The second copy of the commissioning certificates shall be submitted to the Engineer.

The third copy of the commissioning certificate shall be included within the Operating and Maintenance manuals.

In addition, all manufacturers certificates of tests at the specified duties carried out at the manufacturer's works shall be submitted in triplicate as detailed above.

2.22.6 Periodic Inspection and Testing Notice

A periodic inspection and testing notice shall be fitted in a prominent position at or near the origin of the installation in accordance with clause 514.12 of the IET Wiring Regulations.

The notice should read as follows:-

> **IMPORTANT**
> This installation should be periodically inspected and tested and a report on its condition obtained, as prescribed in the IET Wiring Regulations BS 7671 Requirements for Electrical Installations.
>
> Date of last inspection ……
> Recommended date of next inspection ……

2.23 Spares

The Contractor shall include for the supply of the following spares which shall be handed to the client's representative upon completion of the installation works.

a) Cartridge fuses for 13A plug tops, fused connection units, shaver sockets and luminaires shall be provided at the rate of six of each size or type and rating.

b) Two number MCBs of each size used up to 63A.

c) Six spare glasses and cover opening keys for fire alarm break glass contacts. All spare fuses and MCB's shall be housed in a fibre glass or a rust proofed sheet metal cabinet fixed in each main switchroom. The cabinet should be labelled 'SPARE MCB's & FUSES'

2.24 Warning Signage and Treatment of Electric Shock

In all main switchrooms and/or sub-stations a notice shall be provided and fixed in a conspicuous place, which shall be agreed with the Engineer, giving full instructions for the method of treating persons suffering from electric shock. The Contractor shall supply and install on the door leading into main switchrooms and/or sub-stations and on the front of main switchboards, panelboards, distribution boards and switchgear a warning signage of voltage potential and danger. These shall be in accordance with current regulatory standards.

2.25 Rubber Mats

The Contractor shall supply and install an insulating mat to the main switchroom floor. The mat shall be of 10mm thick, 1 metre wide, ribbed tough rubber laid to the front of the switchboard and be the full length of the switchboard.

SECTION 3: Electrical Services: Particular Specification

3.1 General Description of the Works

This Electrical Performance Specification is to detail the proposed design intent of the various electrical Building Services for Dales Museum, Hawes.

The information given in this document should be taken as preliminary and treated as a minimum requirement for the production of detailed designs by the Contractor. Reference should be made to accompanying documentation for conditions of Contract and Tendering procedures. It is a condition of Tender that the Contractor submits with their Tender offer, a materials schedule in accordance with Appendix A of this Specification.

Currently the building has an existing solar PV system installed onto the south facing side of the roof. The solar panels are connected into an existing inverter and generate electricity to provide low-cost power solution to the building to reduce the required power provided by the grid.

The current solar PV system doesn't produce enough electricity to power the building day and night. The project involves the designing and installing battery storage system to the property to store the solar generated DC power during peak hours within the day and discharge the stored power during nighttime when the building is producing the least amount of energy.

This method dramatically reduces the requirement for energy to be purchased from the grid.

The existing solar inverters are string inverters and do not contain the required electrical connections to allow the integration of battery storage systems. Therefore, the current inverter will be disconnected and removed with a hybrid inverter installed and existing string connections re-terminated. The hybrid inverter will then allow for the installation of batteries.

It will be the contractor's responsibility to design and select the correct type of hybrid inverter suitable for the site & installation as well as selecting and sizing the battery system. The batteries are to be sized to store the full generated PV DC current.

The batteries will be wall or floor mounted units to allow for any ventilation and heat dissipation to be released from all angles and wired in parallel.

Extent of information

It is proposed that this Performance Specification will be developed into a detailed design including contract, installation, shop Drawings, technical submissions package by the Contractor as part of the Design and Build contract.

The services contract covers the design, supply, delivery, off-loading, installation and services co-ordination, controls cabling and wiring, testing, commissioning, handing over on completion in a satisfactory working order and replacement of all faulty parts during the defects liability period of all systems, items, parts and apparatus specified in these documents, schedules and drawings.

The Contractor shall include for all works and materials allied and incidental, which are not explicitly specified, but which are necessary to complete the installation as a working whole.

All work shall conform to the best principles of modern practice and shall be carried out by competent tradesmen of the appropriate grades.

By acceptance of the contract the successful Contractor shall accept full responsibility for the successful operation of all the works specified herein.

Inclusion shall be made for transport of all materials, plant and equipment to site, for all necessary off-loading unpacking, storage and assembly. The Contractor shall pay for all associated charges for labour, freightage and demurrage.

The Contractor shall, wherever necessary, pay all fees to manufacturers, suppliers, inspectors etc for attendance installation, commissioning and testing of any part of the electrical plant and / or items of equipment, included in this contract.

This document shall be read in conjunction with the main contract preliminaries and should there be conflict the main contract preliminaries shall prevail.

This document shall be read in conjunction with any accompanying Tender drawings, however, should there be a conflict the Contractor shall raise these prior to accepting any appointment.

Standards

The complete services installation and components shall, unless stated otherwise, comply with the appropriate British Standard (BS and/or BS EN)) or Code of Practice (CP) and where no BS or CP is applicable the Agreement Certificate for the item.

Ensure all equipment and systems are designed and installed in accordance with the relevant standards and that operational compatibility exists between the systems and any other system installed in the same location.

All product and materials shall have product conformity certification (e.g. BSI Kitemark, BSI Safety Mark or CARES scheme) or product approval (e.g. British Board or Agreement Certificate)
All products must have the recognised ‘CE’ mark attached.

Certificates of compliance with British Standards, BSI Certification Schemes, and/or other Quality Assurance Schemes, shall be provided if requested. Notify all authorities in accordance with their regulations and obtain any required approvals for the Works.

When new editions are published during the construction, the instructions of the Client Agent shall be sought regarding any modifications or changes necessary.

References to BSI documents shall be to the versions and amendments listed in the British Standards Catalogue and in subsequent issues of BSI News up to one month prior to the tender issue date.
The tender shall be based on the Regulations current one month prior to the issue date of tenders.
The installer shall produce on site if requested any Code of Practice or British Standard applicable to the Works.

Some of the recently published Codes of Practice contain the following clause:

“In this Code the word “shall” indicates a requirement that is to be adopted to comply with the Code while the word “should” indicate a recommended practice.

Out of Hours Working

Some elements of works shall be required to be undertaken out of normal building operational times. The *Contractor shall therefore include for Premium Time Out of Hours operational working due to remaining parts of the* building being fully operational. For Tender purposes the Contractor shall take 09:00am to 17:00 pm as normal operational times of the building.

Elements of works to be included for out of normal building operational times shall be:

- All penetrations of building fabric.
- Noisy operations.

The Contractor shall co-ordinate all proposed works with the Main Contractor and their Sub-Contractors to ensure phasing and programming milestones are met in full.

The site address is:
Dales Countryside Museum, Station Yard, Burtersett Road, Hawes, DL8 3NT

Electrical Services Drawings

The following Contract drawings have been produced and shall be read in conjunction with this performance specification.

YD2501-APP-DM-00-DR-E-000601- Ground Floor Electrical Layout - Solar PV
YD2501-APP-DM-00-DR-E-000602 - First Floor Electrical Layout - Solar PV

Prior to commencement on site the Contractor shall provide fully coordinated working drawings for each area, which show the complete electrical requirements for the project, no later than 14 days prior to commencement of works on site.

These drawings shall be completed to include the following services.

- Services routes.
- General Containment,
- Small Power,
- Dimensioned room layout & elevation drawings for the proposed battery and inverter room.

3.2 Scope of Works

The scope of the works generally includes, but is not limited to, the following: -

- Carry out site visit to understand the build of the property and explore cable routes and fixing arrangements.

- Site survey, development and production of fully detailed installation working drawings, diagrams, charts, schedules, risk assessments, method statements, programmes etc. necessary to fully describe and implement the proposed installations.

- Negotiation and agreement through the Main Contractor of all programmes and methods to be adopted with the Employer, End User, CDM Health and Safety Co-ordinator and Engineer together with all other trades and specialists.

- All stripping out, modifications, extensions and additions to engineering services as detailed in the following sections of this specification.

- The testing, inspection, commissioning and setting to work of all the above to the satisfaction of the Contract Administrator or the Employers appointed representative including 12 months servicing and maintenance of specialist services and systems.

- The provision of "As Installed" drawings and Operational and Maintenance manuals, CDM and Health and Safety documentation for and associated with the above contract works including all associated system and building log books.

- Handover procedures and employer/end user training and instruction.

The Contractor shall provide all necessary attendance and services requirements associated with all other trades, Sub-Contractors and System Specialists requiring electrical supplies, containment services, interfacing, integration and builder’s work.

The actual location of items of electrical equipment shall be co-ordinated on site after consultation between the Contractor and associated Sub-Contractors, System Specialists, other trades, Employer, and end user in order to co-ordinate fully with the furniture and equipment layouts to prevent clashes with other services and equipment. Where several items of equipment are to be installed in close proximity,

then due consideration shall be given by the Contractor and System Specialists to ensure that a neat, planned and co-ordinated layout is presented.

3.2.1 Procedure for the Inspection, Checking and Issuing of Documents

An electronic copy and 1nr hard copy of the drawings, calculation files and other relevant documents shall be issued to the Engineer/Contract Administrator 'For Comment' no later than 28 days prior to commencement of works on site.

The Engineer/Contract Administrator shall then issue a marked-up copy of the documents and/or a schedule of comments. Each document shall be assigned one of the following status:

- Status A – Accepted – conforms with design intent.
- Status B – Please review in line with comments and resubmit.
- Status C – Rejected – does not conform with design intent.

Once each document has been given a Status A or B it shall be resubmitted as part of the formal construction issue.

The timescale for the Engineer/Contract Administrator to pass comment on drawings, calculation files and other relevant documents issued 'For Comment' shall be 15working days.

Documents shall be prepared in good time to allow the Engineer/ Contract Administrator to carry out thus comment procedure as noted above.

3.2.2 Calculations File

In addition to providing the drawings as noted above, the Contractor shall produce a complete calculation file for the following sections as a minimum:

a. Designers Risk Assessment Sheets.
b. Design Criteria.
c. Load Analysis/Assumptions.
d. Diversity Calculations.
e. Battery sizing

3.2.3 CDM Regulations

The Contractor is advised that the works will be carried out under the Construction Design Management (CDM) Regulations and shall make all necessary allowances as required under the said Regulations, including method statement and risk assessments.

3.2.4 Method Statements

On the award of the Contract, the Contractor shall produce a schedule of method statements for discussion and agreement with the Engineer, together with a programme for their production.
The schedule should include, but not be limited to:

a) Working within and around occupied premises
b) Works requiring connection to (or disconnection from) Electrical plant and equipment.
c) Delivery/removal of major plant items.
d) Any works which may, in the opinion of the Engineer, cause disruption to the day to day running of the building, or adjacent buildings.
e) Forming of secure access routes to work areas through the building.
f) Protection of existing plant and finishes, etc.
g) Forming of a site area handed over (where applicable).

3.2.5 Co-ordination of Services

The Contractor shall ensure that the routing of wiring, containment and positioning of items of equipment do not obstruct or prevent the effective operation of any items of equipment installed by others.

Claims for extras due to lack of liaison and/or co-ordination between trades will not be entertained.

3.2.6 Builders work in Connection with Services

It shall be the full responsibility of the Contractor to identify ALL builders works and incorporation of associated costs into submitted tender.

The Contractor shall be responsible for all cutting away of holes and fixing of containment and cables and the subsequent filling in and making good with relevant fabric/ building material to match area.

The Contractor shall obtain the permission of his Structural Engineer before drilling any holes/apertures/changes in structural steelwork or structural beams, columns or decks etc.

All holes through building fabric/walls, etc. shall be cut as carefully as possible and made up solid after completion.

Chases in plaster, brickwork and concrete shall be sufficiently deep to give 13mm covering to all conduits and fastenings, be neatly executed, and of minimum width. The cost of all unnecessary cutting away and making good occasioned by faulty marking out and/or incorrect instructions being given by the Contractor shall not be chargeable to Align Property Partners and shall be borne by the Contractor.

The Contractor shall be responsible for the design, provision and installation of all necessary fixings, brackets, supports, braces, hangers etc. as may be necessary to complete the installation.

All dimensions shall be verified on site.

The Contractor shall include for all builders work in connection with the works. Any damage to the fabric finishes and structure, footpaths, roadways etc. of the existing and surrounding buildings due to negligence shall be corrected at the Contractors own expense.

The builders work shall consist of the following elements;

1. The making good of all walls, ceiling and floors following the removal of all redundant equipment.
2. All cable penetrations including suitable fire sealing to new and existing penetrations where penetrations are between rooms and spaces.
3. All associated bracketry and equipment to mount the cables and batteries

3.2.7 Site delivery

The Contractor shall allow for all deliveries of their PV systems and electrical equipment in a controlled and managed sequence of work. All deliveries shall be programmed with the Project Manager and site manager with at least 3weeks notice.

It is important that all deliveries of equipment have accompanying Method statement and risk assessments submitted and an agreement in place with the Project Manager and Site Manager.

3.2.8 Meetings

Attend site
The Contractor shall visit site and survey the proposed building, roofs and produce layout drawings to demonstrate the performance requirements of this specification will be achieved. The Contractor shall liaise with Align Project Manager to agree the location on the electrical point of connection and the associated service route.

Progress meeting
The Contractor shall allow for the attendance to weekly site progress meetings during the course of the installation works. The contractor shall prepare a progress report in writing show the works progression against the programme, Health and Safety, Material, labour and any risk items shall be identified.

MS Teams Meetings
Where suitable and practical, some of the meetings will be conducted on MS Teams

3.2.9 Fire Stopping

BS7671:2018 Regulation 527.2 sets out the requirement for the sealing of wiring system penetrations through elements of a building construction. The Contractor shall appoint a specialist third-party accredited installer to carry out fire stopping works.

These include.

- Between the electrical, switch room and adjacent spaces.
- Within risers
- Any fire compartments

3.2.10 Programme of Works

The Works shall be carried out in a sequence and manner; reference should be made to the Conditions of Contract and Preliminaries for the proposed commencement, duration, sequence and completion dates.

The Contractor shall prepare and agree a master phasing programme of work for to meet contractual commitments which shall be returned with their tender.

The master programme shall include specific details of the intended starting and completion dates for all the principal sub-divisions of the works including Sub Contractors. Evidence shall be provided that the Contractor has an adequate labour force available for the duration of the contract to ensure the programme dates on are achieved, and that his suppliers, specialist Sub-Contractors and nominated suppliers can provide the required services and materials at the required time.

The responsibility for preparing an accurate and practicable programme and for complying with it rests entirely with the Contractor. Where appointed under a Building Main Contractor then this programme information shall be integrated into the main project programme for the works.

The Contractor shall ensure that adequate allowance is made in the programme for commissioning of the engineering services installations.

3.2.11 Operating and Maintenance Instructions

No later than four weeks prior to the end of the commissioning provide two draft copies of the manual for comment.

Issue the final version of the manuals 3no hard copies and one digital on completion of the works.
Each manual to be A4 size, in plastic covered loose leaf four ring binders with hard covers, indexed, divided and appropriately titled.

Ensure each manual contains, but not limited to the following information;

- Index
- A full technical description of each system written to ensure that the Employer's staff fully understand the scope and facilities provided.
- A description of the mode of operation of each system.
- A list of record drawings with a brief description of each.
- A legend for all colour coded services
- Schedules, system by system, of plant and equipment stating their locations, duties and performance figures.
- The manufacturers name, address and telephone number for each item of plant and equipment together with catalogue list numbers.
- Manufacturers technical literature for all items of plant and equipment.
- A copy of all test certificates
- A copy of all completion certificates
- A copy of all manufacturers guarantees and warranties.
- A schedule of all equipment settings established during commissioning.
- Procedures for seasonal changeovers.
- Recommendations as to the preventative maintenance frequency and procedures to be carried out to ensure efficient operation.
- Recommended lubricants.
- A list of normal consumables.
- A list of recommended spares.
- A guide to fault finding.
- Starting up, operating and shutting down procedures for all equipment and systems.
- A copy of each record drawing.
- A list of emergency telephone numbers.

Edit manufacturers' standard operating and maintenance instructions to ensure only that information relevant and pertaining to the works is used.

3.2.12 Design Guides

The proposed installation and design of the electrical engineering services installation will be based on the following design criteria;

- British Standards, Codes of Practice and Building Regulations
- CIBSE Guides and Technical memoranda
- BS7671: Requirements for Electrical Installations
- Local and Statutory Authority Requirements
- Supply Authority Regulations
- Building Regulations Approved Document Part 2013 ‘L2’
- BS 9999 and BS 5839-1 2017

3.3 Enabling Works

When assessing the proposed works and preparing the Tender return, the Contractor shall provide information and costs to the Main Contractor to ensure any works deemed part of the enabling and shall be included within the Electrical Tender Schedule. The Main Contractor shall be informed of any building works requirements to ensure costs are portioned within the Main Tender Document.

3.4 LV Distribution and Sub Distribution

Existing Main Switchgear

The existing electrical incoming supply to the site terminates within a three phase Northern Powergrid cut-out and associated E.ON meter, located within the External Barn shed to the south of the main carpark which shall both be retained and reused.

Distribution Boards

All existing distribution boards shall be retained and re-used. The contractor shall allow for the replacement of the existing TP MCB Type 'C' to a suitable sized protective device that feeds the new hybrid Inverter. The contractor shall install the correct Amperage circuit breaker.

Final Circuit Wiring

From the new 4pole AC isolator to the hybrid inverter, a 5core SWA cable shall be installed and adequately supported before termination into the new 3phase inverter. Outgoing from the new 3phase inverter to the DC Isolator shall be a correctly sized solar photovoltaic cable.

The Contractor shall ensure all works are carried out is a safe manner by a competent, and suitability qualified electrician.

Any electrical isolation shall be coordinated with the Site manager

3.5 Data and Voice Communications Services

Data Installation

General

The Solar inverter shall be equipped with a data connection either by hard wired connection via CAT6 LSZH B2CA rated cabling and RJ45 end plug or Wi-Fi Hub Connection with connects into the COM port on the underside of the inverter.

It will be the contractor's responsibility to survey and propose the preferred option depending on data accessibility into each inverter's location.

Depending on the battery system proposed, the contractor shall allow for a data connection link between the inverters and battery units to allow for data transferring between the units.

The contractor shall ensure the data connection between inverters and battery units is secured and mechanically protected to suit BS7671 2018 AMD3 and the contractor installed CAT6 LSZ B2CA tested cable.

3.6 Photovoltaic System (PV)

The Contractor shall employ a Microgeneration Certification Scheme approved specialist to design, supply, install, test, commission and certify and modify the existing roof mounted photovoltaic system as indicated on the layout drawings.

The contractor shall desig, supply and install a hybrid inverter to work in conjunction with the existing installed Solar Panels and arrays. Which provides the same rated output current as the existing inverts installed. The system shall be complete with all fixings, wiring, DC isolator, generation meter, inverter etc to provide a complete photovoltaic system and be complete with a minimum 5-year warranty.

The contractor shall submit all manufacturers technical data sheets and calculations to Align Property partners for review and approval. This will include all technical data on the proposed hybrid inverters,

battery manufacture and sizing calculations. The drawings provided make note of a minimum sized battery kWh/day charge/discharge requirement. It will be the contractor's responsibility to check all electrical load information from the buildings energy supplier to ensure that the batteries are acceptable.

All existing PV panels throughout the system shall remain untouched other than disconnection and reconnection of the PV strings into the new hybrid inverter. The contractor will then carry out an electrical continuity test on the DC strings to ensure the connections are still operating and prove no faults are present. The DC strings shall be modified as required to provide a balanced array of Solar PV strings across the new Hybrid inverter. The Contractor shall include for any modification to the DC cable strings to suit the position of the new hybrid inverter.

The PV installation shall comply in all respects with the Standards stated elsewhere in this specification but in particular the IET Regulations, MCS Requirements and BS EN 62446.

The existing inverters have AC rotary isolation switches located adjacent each unit and shall remain in situ. The inverters also have an inbuilt DC rotary isolation switch. The hybrid inverters shall also come equipped with inbuilt DC isolation switch.

Generation and Export Metering

The Contractor shall design, supply and install a generation and export meter system for the Solar PV array to allow the site to measure accurately the consumption and generated energy.

The inverter shall also be provided with the facility to be connected to a data logger or BMS system via a Cat 6 network point. The system shall be provided with the facility to be logged and monitored via web-based software. The software shall be capable of fault monitoring of the inverter, batteries and of the PV module array.

Warning labels shall be supplied by the manufacturer and fitted in their accordance.

A method statement describing the installation, together with a risk assessment, shall be produced and submitted prior to the commencement on site for approval by the Align Property Partners Engineer.

The Contractor shall ensure that all necessary cable tray and galvanised conduit is installed throughout for the System Specialist.

On completion of the installation, the system shall be fully tested and commissioned in accordance with the Standards stated in this specification and electrical and MCS Certification issued.

The manufacturer's technical documents and literature on hand over shall be copied and placed in the O&M manual and a further copy shall be inserted in a ring binder which shall be stored adjacent the generation meter.

A copy of MCS approval shall be issued within the O&M manuals and a copy sent to the Engineer.

3.6.1 – Particular requirements

At Dales Museum, the current solar installation consists of 2no. PV inverters and 68 PV panels with 2 power ratings. They are noted below:

Existing Inverter 1

The first inverter is 4 yrs old and is manufactured by Solis and located in the staff toilets. The inverter is a Solis-3P20K-4G (Serial No. 1607E2208180005). This inverter is 20kW and consists of 3no. PV strings to the south facing elevation on the roof.
The PV panels manufacture is LG with an output of 340W each and a total of 60no. panels which provides 20.40kWp.
The generation of the panels is calculated to be approximately 20849kWh/Annual.
The new system is not set up as a FIT contract and therefore will be the inverter that is getting replaced.

Existing Inverter 2
The second inverter is 1 yrs old and is manufactured by Solis and located within the café loft space. The inverter is a S5-GR3P8K (Serial No. Unknown). This inverter is 8kW and consists of 2no. PV strings to the south facing elevation on the roof.
The PV panels manufacture is JA Solar with an output of 660W each and a total of 8no. panels which provides 5.28kWp.
The generation of the panels is calculated to be approximately 4125kWh/Annual.
The new system is not set up as a FIT contract and therefore will be the inverter that is getting replaced.

The contractor shall decide on a manufacturer of Hybrid solar PV inverters to replace the existing Solis inverter. The preferred choice would be to replace the existing with a Solis Hybrid version. This will assist in connection port's locations and mounted frames and connection details. The hybrid inverter shall be sized at 20kW & 8kW to suit existing.

The Hybrid inverter shall be installed in the same location of the existing and retain all electrical connections where possible. The contractor shall allow for minor alterations to trunking, penetrations, secondary electrical connections relocation etc. it is believed that the hybrid inverter will be larger in height/width/depth.

The contractor shall include for all cabling between the inverter and batteries and ensure it is installed correctly to meet BS7671 2018 AMD3.

The hybrid inverter shall be equipped with data connectivity to allow the system be monitored from both a computer and mobile phone app.

3.6.1.1 – Batteries

At Dales Museum, the total energy consumption throughout the year is 52630kWh/Annual with an approximate 144.2kWh/Day. Throughout 2024 the total night time consumption was 11252kWh/Annum and 30.83kWh/Day. During the 2024 year, there was only a couple of instances where the night time consumption hit around 75kWh, with all other days staying around 30kWh.
The contractor is to design / supply / install / commission the battery system for the building. The purpose of the batteries is to store the energy up during the day and discharge the energy during the night.
Solis inverter 1 generates approx. 57kWh/day.
Solis inverter 2 generates approx. 11kWh/day.

The Electrical Energy Storage System shall meet the following requirements.

- The Battery Storage Standard (MIS 3012) system
- Comply with PAS63100:2014
- IET code of practice for Electrical Energy Storage System (EESSs)
- Components and assemblies shall comply with relevant standards accepted by relevant EU Directives or equivalent UK legislation.
- The EESS shall meet the requirements of the Electromagnetic Compatibility Regulation 2016.
- The Contractor shall ensure that all selected components of composite system are compatible.
- All storage battery and charging equipment installations shall be designed in accordance with BS 7671, BS EN IEC 62485-1 and BS EN IEC 62485-2, considering specific recommendations of the battery manufacturer for accommodation.

Means of protection against electric shock, overcurrent and overload current according to BS 7671 shall be provided for all modes of operation.

Any earth electrodes provided for or utilised by the EESS shall meet the requirements of BS 7671 and BS 7430.

Controls shall be designed and configured to avoid jitter, and nuisance-switching between operating modes.

The storage battery shall cease delivering power before it exceeds its maximum recommended depth of discharge. The batteries shall be sized to store as a minimum the total night time consumption whilst also considering the requirement to leave a minimum of 10% allowance to avoid draining the battery.

The circuit connecting the EESS generator to the installation must be designed so that it is protected against electric shock, fault current and overcurrent in accordance with BS 7671

The batteries used within the Solar PV system shall be Lithium battery LifeP04 prismatic cell which is scalable to allow for maximum flexibility.

- Battery – trip efficiency >95%
- Depth of discharge 90%
- Storage temperature -20 to 55^0C

Ingress protection IP65
Wall or floor mounted

- Over temperature protection, overload protection and over- under voltage protection.

Any store rooms or plant room considered for the inverter and battery storage shall have a structural engineering check of the existing floor to ensure the battery weight can be installed. Final location and layout shall be agreed with the client and project manager before installation.

The battery shall communicate with the inverter and real time web-based portal have the facility to connected to a Building Management system via RS485 cable. Charging and discharging schedule shall be able to be set from the portal.

The batteries will either be wall mounted or floor standing as a stackable unit. The contractor shall carry out investigations and review the best solution to proceed with. If the contractor chooses wall mounted then the following will apply:

The batteries will be mounted on the wall within the external boiler room. The batteries will carry approximately 50kg of weight. The contractor will be required to inspect the wall and install a minimum 18mm Timber board to take the load of the batteries to the front of the wall.

The batteries will require spacing to allow for heat dissipation. The batteries will require between 350-500mm spacing from a wall or electrical unit and 400-600mm spacing between batteries. As the batteries are looking to be wall mounted, they will require a clearance of 55-65mm off the wall which may be achieved by the batteries mounting bracket.

The ventilation required for the battery will depend on the batter chemistry and the enclosure / room characteristics.

All battery enclosures or battery rooms shall comply with BS 7671 and BS EN IEC 62485-1 and BS EN IEC 62485-2, and shall contain provisions appropriate to the battery chemistries involved.

The batteries shall be connected in parallel to reduce the risk of one battery failing and then all batteries failing.

All cabling between the batteries shall be installed in surface mounted PVC trunking with internal metal fixings.

Battery Ventilation

Any gasses emitted from the batteries will need clearing from the room and therefore a continuous extract fan is required installing within the room. When the temperature in the room reaches too high the fan will boost for the period until the temperature drops back down to within its parameters.

Due to the storage size required from the batteries, this will require around 15 modules and will generate a significant amount of heat each and will require extraction system which detects the rooms temperature level. It would be advisable to also install an wall mounted supply fan to bring in fresh cold air to maintain a ambient temperature. The contractor shall design, supply and install a suitable mechanical ventilations system within the battery storage room

Please note that each battery will require a daisy chained Protective Earth cable between each unit and from the inverter to the first battery.

Please note the contractor shall also allow for the points noted below:

- Provide main overcurrent protection to the batteries if the inverter and batteries are not in the same enclosure.
- Install the batteries in a location limited to authorized personnel only.
- Provide sufficient ventilation
- The battery shall be mounted on a structure able to withstand the weight of the batteries.
- Avoid installation within a room that forms part of the escape route.
- Consider COSHH regulations.
- Appropriate safety signs should be installed onto the room entrance door and ground floor mains cupboard door (danger – battery charging area), (Warning: Battery Installed on premises. Location…) Refer to IET Code of practice: Grid Connected Solar Photovoltaic Systems 2nd Edition 'Appendix C C3

The battery storage system shall be complete with a 10year warranty.

Containment Systems

The Contractor shall design, supply and install cable containment and support systems for all AC, DC cables, and sub main cables for the proposed solar PV system.
The contractor shall allow for any unistrut framing system to mount the new hybrid inverter and battery units
.
The Contractor shall develop the routes as part of their coordinated installation drawings, considering all building constraints. The cable containment shall be installed to ensure easy access for future cable installation. The Contractor shall provide their coordinated installation drawings indicating the proposed routes four weeks before installation commences.

Liaison shall take place between the Contractor and other service Sub Contractors in order to fully coordinate the installation of the containment systems and other associated services to avoid service clashes.

The proposed cable containment systems are generally intended to provide containment for cabling of all types, throughout their lengths. The Contractor shall install main cable containment routes and additional subsidiary routes so that all cables are contained/secured from their point of supply to their point of use.

All containment systems installed shall be continuous, installed to the manufacturers recommendations and shall include for all of the required component elements (including metallic compartmental segregation where necessary) in order to present a completed installation. This shall include for all separation and compartmental segregation of different services, particularly between mains power, fire alarms and SELV/data/communications cabling.

The Contractor shall design, supply and install all support systems as required to sustain the applied cable containment and associated cabling weights. All supports and fixings shall be metallic in compliance with BS7671. No plastic rawl plugs or other plastic fixings shall be allowed.

Where cable containment routes or sections of segregated containment containing cabling of dissimilar category types (i.e. power and data/communications) cross over each other the Contractor shall make

allowances to ensure sufficient segregation and cross over methods are maintained in order to mitigate interference between the differing cable category types.

The following list defines the cable containment types proposed, their installation and general usage:

- Galvanised steel tray/ trunking for sub-main cable.
- Galvanised steel tray for DC cables

The Contractor shall ensure that the installation of all containment systems proposed ensures adequate separation of cabling having differing classification bands, with particular attention paid to separating data/communications from power services. The Contractor shall ensure that separation distances are compliant with the distances recommended in the relevant British Standards.

The Contractor shall supply and install suitable fire-resistant material where containment systems pass through walls and/or fire compartments.

3.6.2 – General requirements

The minimum documentation that is required to be provided following the installation of the PV system. This information is to ensure key system data is available to the end user & maintenance engineer. System documentation requirements are as follows:

- Project identification reference
- Rated System Power (kW DC or KVA AC)
- PV Modules and inverters – Manufacture / model / quantity
- Installation date
- Customer Name
- Full Site Address
- Wiring Diagram

The Systems design/install/commission contractor is also responsible for providing the following information:

- Company Details
- Contact Name / Number / Email Address

Wiring Diagram

A single line wiring diagram shall be provided. This diagram shall be annotated to include the following information:

- Array General specifications
    - Module manufacturer & model part no.
    - Total number of modules
    - The DC current rating adjustment factor
    - String configuration (No. modules per string)
    - No. strings per inverter
    - Identification of string numbers to inverter numbers – clearly identifying what connections are included.

AC System

The single line wiring diagram shall include the following AC system information:

- AC isolator location / type / rating
- AC overcurrent protective device location / type / rating

Rating information shall include AC voltage and current ratings.

Labelling & Identification

Inspection of the PV system shall include at least a verification that:

- All circuits / protective devices / switches / terminals are suitably labelled to the requirements of IEC60364 and IEC62548:2016
- All DC junction boxes carry a warning label indicating the active parts inside the boxes are fed from a PV array and may still be live after isolation from the PV inverter and grid supply.
- Means of isolation on the AC side is clearly labelled.
- Dual Supply warning labels are fitted at point of interconnection
- A single line wiring diagram is displayed within each feeder pillar.
- Designer / installer / commissioning engineer & company are displayed in each feeder pillar.
- All signs and labels are suitably affixed and durable.

A method statement describing the installation, together with a risk assessment, shall be produced and submitted prior to the commencement on site for approval by the Align Property Partners Engineer.

The Contractor shall ensure that all necessary cable tray and galvanised conduit is installed throughout for the System Specialist.

On completion of the installation, the system shall be fully tested and commissioned in accordance with the Standards stated in this specification and electrical and MCS Certification issued.

The manufacturer's technical documents and literature on hand over shall be copied and placed in the O&M manual and a further copy shall be inserted in a ring binder which shall be stored adjacent the generation meter.

A copy of MCS approval shall be issued within the O&M manuals and a copy sent to the Engineer.

3.6.3 – Testing

Testing of the electrical installation shall be done according to the requirements of IEC 60364-6.

As a minimum the contractor shall carry out a category 1 test regime. This is the minimum test sequence that is expected and shall be applied.

The system testing needs to address both the AC and DC sides of the PV system. In general, the AC testing should be complete prior to DC testing.

AC Side Testing:

- Test all AC circuits to the requirements of IEC 60364-6.

DC Side Testing:

- Continuity of earthing and/or equipotential bonding conductors where fitted.
- Polarity test
- PV string combiner box test (if applicable)
- String voltage test
- String Current test
- Functional Test
- IR test of DC circuits

3.7 Builders Work

It shall be the full responsibility of the Contractor to identify ALL builders/civil works and as such identify the requirements to the Main Contractor during the Tender period for insertion of costs and meterage etc. into the main bill of quantities. No additional costs shall be permitted nor accepted by Align Property Partners for non-conformance with this requirement. Unless otherwise indicated in this specification, the Contractor at the instruction of the Main Contractor shall be responsible for all cutting away of holes and chases in brickwork, concrete or other building materials, and the excavating of trenches/pits/lightning protection down conductor pits for outside runs of cables/ ducts and the subsequent filling in and resurfacing of trenches/pits and making good with relevant fabric/ building material to match area.

The Contractor together with their System Specialists shall be responsible for providing information to the Main Contractor relevant to the scheduling of all builders' work associated with the Electrical Services.

The Contractor and their System Specialists shall obtain the permission of the Structural Engineer before drilling any holes/apertures/changes in structural steelwork or structural beams, columns or decks etc.

All holes through building fabric/walls, etc. shall be cut as carefully as possible and made up solid after completion. Holes through ceilings and cornices, if applicable, shall be bored from underneath to cause the least disturbance.

Chases in plaster, brickwork and concrete shall be sufficiently deep to give 13mm covering to all conduits and fastenings, be neatly executed, and of minimum width. The cost of all unnecessary cutting away and making good occasioned by faulty marking out and/or incorrect instructions being given by the Contractor and their System Specialist shall not be chargeable to Align Property Partners and shall be borne by the Contractor and their System Specialist.

The Contractor and their System Specialist shall provide plant and equipment foundation drawings for items supplied under the Contract/Sub-Contract and any other Builder's Work drawings necessary for the correct and efficient execution of the work. The Contractor and their System Specialist shall be responsible for the design, provision and installation of all necessary fixings, brackets, supports, braces, hangers etc. as may be necessary to complete the installation as shown on the drawings.

The Contractor and their System Specialist shall provide full details of all holes, ducts chases etc. to Align Property Partners for approval prior to commencement of any builders works. All dimensions shall be verified on site.

Appendix A – Specialist Suppliers, Contractors and Manufacturers

Contractors

GENERAL ELECTRICAL WORKS

Any Specialist and Competent Contractor
NICEIC/ECA Registered and Approved Contractor
Safety Scheme In Procurement (SSIP) Registered
All operatives to carry CSCS cards and be DBS Checked
MCS Approved contractor

Specialists Suppliers

The specialist's works/installation as defined within this specification shall be carried out by one of the following Specialist Sub-contractors, (subject to approval with the Client), under the terms of this contract.

DATA INSTALLATIONS

- Electronic Industries Association/Telecommunications Industry Association (EIA/TIA) 568B-Commercial Building Telecommunications Wiring Standards and subsequent addendums and revisions.
- Fibre Optic cables must comply with BS EN 7718, EIA/TIA 492 specifications for Multi-mode fibres and EIA/TIA 455 for single mode fibres.
- EIA/TIA-569-Commercial Building Standard for Telecommunications Pathways and Spaces.
- International Standards Organisation/International Electrotechnical Commission (ISO/IEC) IS 11801:2002 and subsequent revisions.
- BS EN50173, BSEN 50174 and all subsequent revisions.

SOLAR PV INSTALLATIONS

- MCS (Microgeneration Certification Scheme) Approved Contractor
- BS7671 NICEIC Approved Contractor

MANUFACTURERS

The reference to a named product or to a named supplier shall be construed as setting the standard for a particular article, system or material required.

Where an alternative article, system or material of equivalent standard is available, the Contractor may submit details in the Schedule of Alternatives within the appendices of this specification and shall indicate the cost variance on the Tender sum by comparison with the named product or supplier.

Under no circumstance shall an alternative product to that specified be used without the written approval of the Contract Administrator/Engineer.

Alternative equipment to that specified may be acceptable, only with the advance agreement of the Contract Administrator/Engineer and providing it gives equal or superior quality and performance and has an equal or lower cost in use.

The Contractor shall schedule all proposed alternatives with the submitted Tender together with the cost addition/reduction to the Tender sum.

All specified equipment shall be equal and approved.

NO ALTERNATIVES SHALL BE ACCEPTED AFTER THE TENDER PERIOD.

ALL ALTERNATIVES SHALL BE DEFINED BY THE TENDERER AND ACCEPTED BY ALIGN PROPERTY PARTNERS AT TENDER STAGE.

Galvanised and PVC Trunking, Tray and Conduit

Marshall Tufflex
MK
Legrand

Accessories

MK Electric
Legrand
GEWISS

Switchgear Distribution Boards and Circuit Breakers

Schneider
Merlin Gerin
Square D
Hagar

Solar

Solis
Solax
Fox ESS

Appendix B – Electrical Schedule of Proposed Alternatives-Sub-Letting

	CONTRACTOR PROPOSED ALTERNATIVE COST SUBMISSIONS (State addition or omission from Tender sum)	**Cost** delete as required
1		Add* Omit*
2		
3		
4		
5		
	ITEM OF WORK TO BE SUBLET	**COMPANY DETAILS**
6		
7		
8		

Signed ……

Company……

……

Address……

……

……

……

Date ……

Appendix C – Sample Training Attendance Certificate

YD2501 – Dales Countryside Museum Client User Training

System / Installation	Demonstration By	Date	Client signature
Solar PV Inverter			
Generation Meter			
Battery Storage			

Please note by signing this document the client accepts that satisfactory training has taken place for the operation of the above systems.

Project YD2501 Dales Countryside Museum

Service / System

All services detailed on the above table

Demonstrated by

……

……

Demonstrated to	Signed
1) ……...	……..
2) ……...	……..
3) ……...	……..
4) ……...	……..

Date of demonstration …….

Please note by signing this document the client accepts that satisfactory training has taken place for the operation of the above systems.