HAWDEN
ENGINEERING MEP SOLUTIONS

CARLTON ROAD INDUSTRIAL PARK SOLAR PV
CARLTON ROAD,
ASHFORD,
KENT, TN23 1DP

Section 3
Particular Electrical Specification

TENDER

Job No: 20157
File Ref: 20157-HAW-ZZ-XX-SP-V-0003
Date: December 2021
Rev: T02

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Issue and Revision Record

Rev	Date	Originator	Signature	Checked	Signature	Description
T01	30/11/2021	M. Harris	M. Harris	D. Evans	D. Evans	Tender Issue
T01	14/12/2021	M. Harris	M. Harris	D.Evans	D. Evans	Tender Issue

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20157

Hawden MEP Ltd

Ashford Borough Council

ABC - Carlton Road

20157-HAW-ZZ-XX-SP-V-0003-PRELIMS

14-12-2021

Provision of solar photovoltaics for bulk export to existing light industrial park in Carlton Road, Ashford, Kent.

Contents

PM_10
Project information

Project management

PM_10_10_60/10 Project description

1. Project reference: 20157
2. Project title: ABC - Carlton Road
3. Project description: Provision of solar photovoltaic array for bulk export to the light industrial park known as Carlton Road, Ashford.

PM_10_10_60/20 Drawings and other documents

1. Details: Reference should be made to Document 1 - Schedule of Information for the full list of submitted Tender information.
2. Status: Tender
3. Format: Electronic.
4. Provision: Provided.
5. Contract drawings
   - 5.1. Generally: The same as the tender drawings.
   - 5.2. CAD data: In accordance with BS EN ISO 19650-1
6. Cross-references
   - 6.1. Accuracy: Check remainder of the annotation or item description against the terminology used in the cited section or clause.
   - 6.2. Related terminology: Where a numerical cross-reference is not given the relevant sections and clauses of the Specification will apply.
   - 6.3. Relevant clauses: Clauses in the cited specification section dealing with general matters, ancillary products and execution also apply.
   - 6.4. Discrepancy or ambiguity: Give immediate notice in writing setting out the nature and assessed impact of the conflict. Do not proceed until instructions are received.
   - 6.5. Document precedence: Specification takes precedence over referenced documents.
7. Dimensions: Use numbered dimensions only. Do not scale direct from drawings.
8. Additional copies: Issued on request subject to an administration charge.

PM_10_10_60/50 Surrounding land and building uses

1. Details: The Contractor shall note the site is within an area consisting of a wider industrial estate.

PM_10_10_60/80 The works/ services

1. Details: The Contractor shall be required to carry out the supply, installation, testing and commissioning of the electrical services based upon the design parameters set out within this specification and associated drawings.

   The electrical services installations shall be installed to the minimum requirements of all sections of the tender documentation.

   The installation shall also comply with all relevant British Standards, Building Regulations and all associated guidance notes.

   Before the Contractor commences work on site, meetings shall be arranged on site with the Architect or Building Services Engineer to co-ordinate exact services routes, proposed positions of equipment and methods of installation. A good/neat installation is required that is coordinated

with other trades. Any work that is installed prior to the agreement of the above with either the Employer Representative or Consultant which is later found not to be acceptable shall be removed at no extra cost to the project.

2. Related works: The services design and installation shall comply with the requirements of the specification and comply with all relevant regulations, standards, guidelines and provisions as set out in the tender documents.

   The Contractor will be required to supply, install, connect, test, commission and set to work, the building services detailed herein, which shall include, but not be limited to, the following:-

   2.1. Electrical distribution systems: inclusive of all cabling, fuse boards, distribution boards and protective devices associated with the operation of the installation;

   2.2. Electrical containment systems: inclusive of all cable tray, basket, hangers and support systems, bracketry etc. associated with the installation;

   2.3. Small power systems: inclusive of all cabling, power outlets, mechanical power supplies and fused connection units associated with the operation of the installation;

   2.4. Lightning protection systems: inclusive of all conductor tape, earth rods, bonds and all elements associated with the operation of the installation;

   2.5. Photovoltaic systems: inclusive of all photovoltaic panels, control panels, inverters, cabling and all elements associated with the operation of the installation.

3. Contractor design portion:: The Contractor shall be required to undertake the detailed design and coordination of the entire electrical systems, to provide a complete, safe and functional installation.

   3.1. Electrical distribution systems: inclusive of all cabling, fuse boards, distribution boards and protective devices associated with the operation of the installation;

   3.2. Electrical containment systems: inclusive of all cable tray, basket, hangers and support systems, bracketry etc. associated with the installation;

   .3. Small power systems: inclusive of all cabling, power outlets, mechanical power supplies and fused connection units associated with the operation of the installation;

   3.4. Lightning protection systems: inclusive of all conductor tape, earth rods, bonds and all elements associated with the operation of the installation;

   3.5. Photovoltaic systems: inclusive of all panels, wiring, inverters, isolators and registration of the system associated with the operation of the installation.

   3.6. Plant, equipment and service routes: in accordance with requirements set out by all relevant regulations and manufacturers;

   3.7. Maintenance access: in accordance with requirements set out by all relevant regulations and manufacturers;

   3.8. Plinths, bases and support systems: in accordance with requirements set out by all relevant regulations and manufacturers;

   3.9. Builderswork: inclusive of all penetrations and re-instatement of fire barriers;

   3.10. Planning Requirements: inclusive of the production of any documentation required to discharge and meet planning requirements;

   3.11. Evidence: The Contractor shall provide the following information as an absolute minimum as part of the design:

- Sketch drawings;
- Schematic drawings;
- Installation drawings, shop drawings, manufacturer's drawings;
- Builder's work drawings;
- Installation wiring diagrams;
- Record drawings;

The Contractor shall complete the design and detailing of the work and provide complete production information (including, as appropriate, fabrication/installation drawings, specifications, etc.) based on the drawings, this specification and other information provided, liaising with the Employer's Agent, Planning Supervisor, Principle Contractor and others as necessary to help ensure co-ordination of the work with related building elements and services.

The Contractor shall request additional information as necessary from the Principle Contractor and provide information as necessary in time to meet the programme.

The Contractor shall liaise with the Principle Contractor and others as necessary to help ensure co-ordination of the work with related building elements and services (existing and proposed). Provide drawings and other information as specified showing such details of the work as the Employer's Agent may reasonably require.

Ω End of Section

PM_40
Design and approvals information

Project management

PM_40_60_05 Activities terminology

1. Advise: See 'Communicate'.
2. Agree: See 'Communicate'.
3. Approve: Record conformance of work to specified criteria by giving formal or official sanction.
4. Communicate: Includes advise, inform, agree, confirm, notify, seek or obtain information, consent or instructions, or make arrangements.
5. Confirm: See 'Communicate'.
6. Ease: Adjust moving parts of designated products, systems or work to achieve free movement and good fit in open and closed positions.
7. Fix: Receive, unload, handle, store, protect, place and fasten in position; dispose of waste and surplus packaging; to include labour, materials and site equipment for that purpose.
8. Give notice: Communicate in writing to the person administering the Contract at the address listed therein.
9. Inform: See 'Communicate'.
10. Keep for recycling: As 'keep for use' but relates to a naturally occurring material rather than a manufactured product.
11. Keep for reuse: Do not damage designated products, systems or work. Clean off bedding and jointing materials. Stack neatly, adequately protect and store until required by the Employer or Purchaser, or for use in the Works as instructed.
12. Make good: Execute local remedial work to designated work. Make secure, sound and neat.
13. Match existing: Provide products and work of the same appearance and features as the original, excluding ageing and weathering. Make joints between existing and new work as inconspicuous as possible.
14. Notify: See 'Communicate'.
15. Quote: Use 'Estimate'.
16. Recycle: Collect, sort, process and convert discarded or recovered components into raw materials for use in the creation of new products.
17. Refix: Fix previously removed products.
18. Remove: Disconnect, dismantle as necessary and take out the designated products or work, together with associated accessories, fixings, supports, linings and bedding materials. Dispose of unwanted materials.

    Removal of an item excludes removal and disposing of associated pipework, wiring, ductwork or other services.

    Removal of a system includes this work.
19. Remediate: Action or measures taken to lessen, clean-up, remove or mitigate the existence of hazardous materials existing on a property; in accordance with standards, specifications or requirements as may be required by statutes, rules, regulations or specification.
20. Repair: Execute remedial work to restore something to its original working state. Make secure, sound and neat.

    Excludes redecoration and replacement.
21. Replace: Supply and fix new products matching those removed. Execute work to match the original new state of that removed.

22. Reuse: Recover complete items to be fixed or used in the project or elsewhere without the requirement for recycling.
23. Submit: Deliver in a specified format to a specified person within a specified timeframe.
24. Submit proposals: Submit information in response to specified requirements.
25. Supply and fix: Supply of products, components or systems to be fixed, together with everything necessary for their fixing.

PM_40_60_22 Data security policy

1. Records: Retain, make available for inspection and supply on request information reasonably required to allow response to requests made under the provisions of the Freedom of Information Act .
2. Received requests: Obtain instruction before proceeding.

   Do not supply information to those who are not project participants without express written permission.
3. Confidentiality: Maintain at all times.

PM_40_60_23 Description terminology

1. Attendance: Includes:
   The use of the Main Contractor's temporary roads, pavings and paths, standing scaffolding, standing power operated hoisting plant;
   The provision of temporary lighting of an equivalent brightness to the finished lighting brightness;
   The provision of water;
   The clearing away of rubbish and paying all charges in connection with its disposal, the provision of secure hard standing space for the sub-contractor's own offices, plant and material storage;
   The use of standing mess rooms, sanitary accommodation and welfare facilities and
   The provision of all Health and Safety facilities and all Fire Safety precautions, services, equipment, signage, facilities, marshals and the like necessary to comply with the relevant parts of the Joint Fire Code.
   Additional requirements should be described as 'Special attendance'.
2. Building Manual: A document containing information of use to subsequent building owners, occupiers and users about the requirements and procedures for effective operation, maintenance, decommissioning and demolition of the building.
3. Construction Work: Permanent work together with temporary work.
4. Contractor : The party who undertakes to perform the services, supply goods or carry out work defined in a contract. Includes Main Contractor, Prime Contractor, Supplier, Service provider, Builder, Subcontractor, etc. as the context dictates, which may be defined terms in certain standard contract forms.
5. Contractor's choice: Selection delegated to the Contractor, but liability to remain with the specifier.
6. Contractor's design: Design to be carried out or completed by the Contractor, supported by appropriate contractual arrangements, to correspond with specified requirements.
7. Cost: The amount paid or given by one party to another in exchange for goods, work, supplies or services.
8. Designer: A person or organization carrying out design on a project.
9. Deviation: Difference between a specified dimension or position and the actual dimension or position.
10. Drawings: Definitions as BSRIA Building Applications Guide: Design framework for building services. 5th edition
11. Employer: The party to the Contract for whom the goods, work, supplies or services are provided. Includes Client (in consultancy contracts and CDM Regulations), the Employer, Building owner or Purchaser (in construction contracts), the Developer (in development agreements and funding agreements), or the 'Main' contractor in contractor/ subcontractor agreements - which may be defined terms in certain standard contract forms

12. Estimate: An approximate evaluation of quantity, number, extent, time or cost of part or the whole of a project.
13. Execute: To complete a task fully and put into effect. To fix, apply, install or lay products securely, accurately, plumb and in alignment.
14. Existing: Items retained in place to receive new work.
15. Fastener: Device for mechanically attaching something to something else.
16. Manufacturer and Product reference: Manufacturer – the person or legal entity under whose name or trademark the particular product, component or system is marketed.

    Product reference – the proprietary brand name and/ or identifier by which the particular product, component or system is described.

    References are as specified in the manufacturer's technical literature current on the date specified.
17. Manufacturer's standard: Where used in conjunction with a specified proprietary product, accessories to be those recommended by the product manufacturer.
18. Permanent Work: Work to be constructed and completed in accordance with the Contract.
19. Price: An indication of the amount required to be paid by one party to another in exchange for goods, work, supplies or services.
20. Product: Material, both manufactured and naturally occurring, goods and accessories for permanent incorporation into the Works.
21. Requirements: A description in outline or detailed form of the development, or a part of it, which one party wants another to undertake, design and/or construct.
22. Schedule of rates: The subdivision of product and execution prices by a pre-determined unit basis.
23. Schedule of Work/ Work Schedule: The subdivision of work items by a pre-determined classification. Can form the basis of a pricing document where Bills of Quantities are not used.
24. Schematic: A drawing of a system showing components, products, systems and their interconnections.
25. Site equipment: The Contractor's apparatus, appliances, machinery, vehicles or things of whatsoever nature required in or about the construction for the execution and completion of the Works and the remedying of defects.

    Includes Appliances, vehicles, consumables, tools, temporary work, scaffolding, cabins and other site facilities.

    Excludes: Temporary work, Employer's products and equipment or anything intended to form or forming part of the permanent Works.
26. Specification: Written description of requirements.
27. System: Products, components, equipment, accessories, controls, supports and ancillary items, including installation, necessary for that section of the work to function.
28. Temporary work: Incidental work to undertaken during construction but not intended to form part of the completed work.

Ω End of Section

Ro
Roles

Roles

Ro_10_20_14 Client (K)

1. Name: Ashford Borough Council
2. Address: Civic Centre, Tannery Lane, Ashford, Kent, TN23 1PL
3. Contact: Giles Holloway
4. Telephone: 01233 330427
5. Email address: giles.holloway@ashford.gov.uk

Delivery team roles

Ro_30_10_19/10 Engineer

1. Name: CTP Consulting Engineers
2. Address: Suffolk House, 154 High Street, Sevenoaks, Kent, TN13 1XE
3. Contact: Neil Taylor
4. Telephone: 01732 740195
5. Email address: neil.taylor@ctp-llp.com

Official roles - No Amendments

Design roles

Ro_50_10_03 Architect (A)

1. Name: RDA Consulting Architects Ltd
2. Address: Evegate Park Barn, Evegate, Smeeth, Ashford, Kent, TN25 6SX
3. Contact: Michael Head
4. Telephone: 01303 814455
5. Email address: michael@rdaarchitects.co.uk

Ro_50_20_30 Electrical services engineer (E)

1. Name: Hawden MEP Ltd
2. Address: First Floor Brogdale Enterprise Suite, Brogdale Farm, Brogdale Road, Ospringe, Faversham, Kent, ME13 8XZ
3. Contact: Mark Harris
4. Telephone: 01795 538527
5. Email address: markh@hawden-mep.co.uk

Ro_70_10_75 Quantity surveyor (Q)

1. Name: Costplan Group
2. Address: Unit 15, The Oak Trees Business Park, Orbital Park, Ashford, Kent, TN24 0SY
3. Contact: James Mitchell
4. Telephone: 01233 333532
5. Email address: jmitchell@cpsqs.com

Ω End of Section

Specification created using NBS Chorus

20157

Hawden MEP Ltd

Ashford Borough Council

ABC - Carlton Road

20157-HAW-ZZ-XX-SP-V-0003

13-12-2021

Provision of solar photovoltaics for bulk export to existing light industrial park in Carlton Road, Ashford, Kent.

Contents

Ss_70_10_70_35
Grid-connected photovoltaic systems

Systems

Ss_70_10_70_35 Grid-connected photovoltaic systems

1. Description:

The Contractor shall allow for the detailed design, supply, installation, testing and commissioning of a solar photovoltaic (PV) system for each unit, as detailed below. This shall include the photovoltaic array and associated hardware, bracketry and support systems, and system components to allow connection into the electrical systems.

Each industrial unit shall comprise of a dedicated array, though the system shall feed into a common inverter and wider electrical system for bulk export from the site. It is not intended that any of the electricity generated by the PV system shall be used by the individual units. Once at the inverter position, the various inverters across the site shall link back to a common MCCB panel board located in a GRP enclosure next to the existing substation.

For the purposes of this section, the PV system shall comprise of the PV array, string cabling, optimisers, DC and AC isolation and the PV inverter located within the GRP kiosk.

The PV system shall comprise of the following core components:

- PV Array
- PV AC/DC Smart Optimisation Inverter
- DC Isolation
- AC Isolation
- Interconnecting Cabling
- PV Optimisation Controller (cost option)

All photovoltaic panels are to be SunPower Maxeon 3 SPR-MAX3-400 modules or equal and approved.

The smart optimisation inverters are to be Solar Edge HD Wave SEXXXXH series or equal and approved.

As a cost option, each photovoltaic panel is to be supplied and fitted with a Solar Edge power optimiser to make each panel 'smart' and enable individual monitoring and control by the inverter.

Initial indicative layouts have been provided for each of the units for pricing, however, it shall be the Contractors responsibility to undertake the detail design, layout, support systems design, coordination and installation of the system. All layouts, quantities and system sizing has been provided indicatively for Tendering purposes only as follows (Note - there is no Unit 13):

Plot 1 - 21.2kWp equivalent to 28no panels;
Plot 2 - 15.6kWp equivalent to 39no panels;
Plot 3 - 16.0kWp equivalent to 40no panels;
Plot 4 - 16.0kWp equivalent to 40no panels;
Plot 5 - 9.6kWp equivalent to 24no panels;
Plot 6 - 20.8kWp equivalent to 52no panels;
Plot 7 - 20.8kWp equivalent to 52no panels;
Plot 8 - 20.8kWp equivalent to 52no panels;
Plot 9 - 20.8kWp equivalent to 52no panels;

Plot 10 - 20.8kWp equivalent to 52no panels;
Plot 11 - 20.8kWp equivalent to 52no panels;
Plot 12 - 20.8kWp equivalent to 52no panels;
Plot 14 - 18.4kWp equivalent to 46no panels;
Plot 15 - 24.8kWp equivalent to 62no panels;
Plot 16 - 14.4kWp equivalent to 36no panels;
Plot 17 - 14.4kWp equivalent to 36no panels;
Plot 18 - 17.2kWp equivalent to 43no panels;
Plot 19 - 14.4kWp equivalent to 36no panels;
Plot 20 - 14.4kWp equivalent to 36no panels;
Plot 21 - 17.2kWp equivalent to 43no panels;
Plot 22 - 14.4kWp equivalent to 36no panels;
Plot 23 - 45.6kWp equivalent to 114no panels;
Plot 24 - 33.6kWp equivalent to 84no panels;
Plot 25 - 37.2kWp equivalent to 93no panels;
Plot 26 - 33.6kWp equivalent to 84no panels;
Plot 27 - 37.2kWp equivalent to 93no panels;
Plot 28 - 37.6kWp equivalent to 94no panels;
Plot 29 - 41.6kWp equivalent to 104no panels;

All PV panels shall be suitably fixed to the roofs under recommendation of the solar PV specialist.

The PV inverters are to be located at ground floor level within the green GRP enclosures. Enclosures have been indicatively positioned to make best use of the soft landscaping for distribution of sub-mains cabling around the site and back to the main export position. All GRP enclosures are to be by Enclosure-Tec and mounted on a suitable concrete plinth with pre-formed slot for duct access. The enclosures shall house all isolation, and inverters necessary for the system operation. PV system cabling shall be run surface fixed to the rear or side of the industrial unit as appropriate on galvanised cable tray with a capping lid for security.

The Contractor shall make allowance to bond each new PV system array to the existing building mounted lightning protection system.

Each inverter position shall be fitted with a PV generation meter, with a final export meter provided at the main MCCB panel board position. The Contractor shall carry out all relevant G99 applications as required from a connection of this scale, including all liaisons and site attendance required with the DNO (UK Power Networks).

Liaison shall also be required with Laser who are the Borough Councils specialist energy agent. Setting up of the export agreement shall need to be undertaken alongside Laser.

At hand over, the Contractor shall provide sufficient information to the Employer, detailing maintenance and cleaning regimes to maintain system performance.

2. System manufacturer: Microgeneration Certification Scheme accredited.
3. Input source: Pr_60_70_65_63 Photovoltaic modules
4. Mounting: Contractor's design
5. Switchgear and controls: Contractor's design
6. Cable type: Pr_65_70_48_90 Thermosetting insulated and thermoplastic sheathed (LSHF) armoured cables Type A
7. Cable sizes: Contractor's design
8. Rewireable installation: Required.
9. Concealed installation: Required.
10. Cable containment: Pr_65_70_11_71 Rigid conduit

11. System accessories: Pr_65_72_27_50 Mains power supply transient overvoltage suppression devices
12. Execution: Ss_70_10_70/630 Installing PV module arrays; Ss_70_10_70/660 Installing d.c. isolation switches; Ss_70_10_70/690 Installing a.c. isolation switches; Ss_70_10_70/730 Installing energy meters; Ss_70_10_70/740 Connection to electricity distribution network; Ss_70_10_70/750 Earthing and equipotential bonding; Ss_70_10_70/760 Connection to lightning protection system; Ss_70_10_70/770 Labelling
13. System completion: Ss_70_10_70/810 Testing and commissioning photovoltaic systems; Ss_70_10_70/820 Documentation

Products

Pr_60_70_65_63 Photovoltaic modules

1. Description: PV panels are to be installed in accordance with the description above and as detailed by the Contractor.
2. Manufacturer: SunPower Maxeon or equal and approved
3. Standards: To BS EN IEC 61730-1 and BS EN IEC 61730-2.
4. Third party certification: MCS Certified Product
5. Application class: To BS EN 61140, Class II.
6. Cell type: Monocrystalline to BS EN 61215-1.
7. Format: Welded frame modules.
8. Framework
    8.1. Material: As recommended by Contractor.
    8.2. Colour: Manufacturers standard
9. Module interconnections
    9.1. Standard: To BS EN 62852.
    9.2. Module connectors: Polarized and suitably rated for the applicable d.c. voltage and current.
    9.3. Ingress protection (minimum): To BS EN 60529, IP65.
10. Nominal output of module
    10.1. Peak power: 400Wp
    10.2. Power output tolerance: 0/3%.
11. Output warranty: Minimum of 90% power output after 25 years.

Pr_65_70_11_71 Rigid conduit

1. Description: Rigid conduit to be used in final connections to equipment. Where run externally, all rigid conduit to be in galvanised steel with galvanised clips and fixings.
2. Manufacturer: Contractor's choice
3. Standards: To BS EN 61386-1 and BS EN 61386-21.
4. Mechanical properties
    4.1. Resistance to compression: Medium.
    4.2. Resistance to impact: Medium.
5. Transport, installation and application
    5.1. Lower temperature (minimum): -5°C.
    5.2. Upper temperature (maximum): 90°C.
6. Resistance to bending: Rigid.
7. Electrical characteristics: With electrical continuity properties.
8. Resistance to external influences

8.1. Protection against ingress of solid objects (minimum): To BS EN 60529, IP3X.
8.2. Protection against ingress of water (minimum): To BS EN 60529, IPX0.
9. Resistance to corrosion: High protection, inside and outside.
10. Tensile strength: Light.
11. Resistance to flame propagation: Non-flame propagating.
12. Colour: Standard finish
13. Sizes (OD): To suit installation - final containment, fixings and bracketry part of CDP elements.
14. Execution: Pr_65_70_11/721 Installing rigid metallic conduit

Pr_65_70_48_90 Thermosetting insulated and thermoplastic sheathed (LSHF) armoured cables Type A

1. Manufacturer: Contractor's choice
2. Standard: To BS 6724.
3. Third party certification: British Approvals Service for Cables (BASEC) certified.
4. Size: Contractor's design
5. Insulation: Contractor's design
6. Sheath colour: Black.
7. Reaction to fire class
   7.1. Fire behaviour: C_{ca}.
   7.2. Additional classification for smoke production: s1b.
   7.3. Additional classification for flaming droplets and/ or particles: d2.
   7.4. Additional classification for acidity: a2.
8. Execution: Pr_65_70_48/680 Installing low voltage armoured cables

Pr_65_72_27_50 Mains power supply transient overvoltage suppression devices

1. Description: To be provided to main electrical connection to site LV network.
2. Manufacturer: Contractor's design
3. Standard: To BS EN 61643-11, type 1.
4. Operating voltage and frequency (nominal): 400 V at 50 Hz.
5. Number of poles: 3P&N
6. Maximum continuous operating voltage (Uc): 500 V.
7. Mode of protection: Lines to earth, lines to neutral, neutral to earth.
8. Lightning impulse current (Iimp): Contractor's design
9. Nominal discharge current (In): Contractor's design
10. Maximum discharge current 8/20µs (Imax): Contractor's design
11. Minimum short-circuit current rating (Isccr): Contractor's design
12. Voltage protection level (Up): Contractor's design
13. Open circuit voltage (Uoc): Contractor's design
14. Thermal overload protection: Contractor's design
15. Protection status indicators: Contractor's design
16. Remote monitoring: Contractor's design
17. Ingress protection (minimum): To BS EN 60529, IP20.
18. Mounting method: Suitable for 35 mm DIN rail.
19. Execution: Pr_65_72_27/610 Installing surge protective devices for low voltage power supplies

Execution

Pr_65_70_11/721 Installing rigid metallic conduit

1. General requirements: To be used in all high risk areas or where additional mechanical protection is required.
2. Fixings: Saddle.
3. Joints: Screwed.
4. Threaded conduits: Tightly screw to ensure electrical continuity, with no thread showing.
5. Conduit connections to boxes and items of equipment, other than those with threaded entries: Earthing coupling with male brass bush and protective conductor.

Pr_65_70_48/635 Installing low voltage cables

1. Standard: In accordance with BS 7671.
2. Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
3. Preparation: Store cables above 5°C for 24 hours before installation.

   Clear cable path of debris.
4. Installation temperature (minimum): 5°C.
5. Cables: Install in one length. Dress cables flat, free from twists, kinks and strain.
6. Cable pulling: Do not overstress. Prevent kinks and twisting of the cable.
7. Cable protection: Cables passing through walls and floors to be sleeved with conduit or pipeduct to a minimum of 300 mm. Bush at both ends. Ensure that appropriate fire stopping materials are used to maintain the original fire integrity of the wall or floor around the penetration.
8. Concealed cable runs to wall accessories: Run vertically from the accessory.
9. Exposed cable runs: Direct to surface.
10. Distance from other services running parallel (minimum): 150 mm. Position cables below heating pipes.
11. Jointing and termination
    - 11.1. Final circuit cables: At electrical accessories only.
    - 11.2. Core connections: Using compression lugs to equipment without integral clamping terminals.
    - 11.3. Terminating cables when not using glands: Take sheathing of cables into accessory boxes and equipment and protect against abrasion with grommets.

Pr_65_70_48/680 Installing low voltage armoured cables

1. General requirements: Pr_65_70_48/635 Installing low voltage cables; Pr_65_70_48/685 Jointing and terminating low voltage armoured cables
2. Earthing: Bond armour to equipment and main earthing system.
3. Connections to apparatus: Moisture proof, sealed glands and shrouds.

Pr_65_70_48/685 Jointing and terminating low voltage armoured cables

1. Preparation
   - 1.1. Cable ends: Cut immediately before jointing or terminating.
   - 1.2. Cables left unconnected for more than 24 h: Seal to prevent moisture ingress.
2. Cable stripping
   - 2.1. Length of exposed cores and conductors: Minimize. Leave no exposed conductor after termination.

2.2. Strands: Do not damage when stripping cable cores. Twist together. Do not reduce number. Secure at terminations.

3. Joints and terminations: Use qualified cable jointers, using jointing materials, components and installation techniques recommended by the cable manufacturer and the jointing accessory manufacturer.
4. Tooling certificate: Submit before installing connectors.
5. Cable glands: To BS EN 62444 and fitted with shroud.
6. Cold pour resin and heat shrink joints: To BS EN 50393.
7. Insulating tape: To BS EN 60454-1.
8. Plastics sheathed cables: Seal with proprietary shrink-on end caps.
9. Bolted terminal connections to equipment and switchgear without integral cable clamping terminals: Compression type lugs, of correct bore.
10. Compression joints: Provide in accordance with BS 7609.
11. Conductor labelling: Identify cable conductor cores at each end of cable and at joints.
12. Unused cable cores: Connect to earth.

Pr_65_72_27/610 Installing surge protective devices for low voltage power supplies

1. Standards: In accordance with BS 7671 and DD CLC/TS 61643-12.
2. Point of installation: On a.c. side of photovoltaic system inverter.
3. Mounting arrangement: Separate enclosure.
4. Connection arrangement: Contractor's design
5. Interconnecting cable
   5.1. Cable type: Device manufacturer’s standard.
   5.2. Cable size: Device manufacturer’s standard.
   5.3. Cable length (maximum): 500 mm.
   5.4. Cable installation: Tightly bind connecting leads together.

Ss_70_10_70/620 Installing photovoltaic systems generally

1. Standards: In accordance with BS 7671 and EREC G98. In accordance with BS 7671 and EREC G99. In
2. Installer: Microgeneration Certification Scheme accredited.
3. Materials: Separate dissimilar metallic materials to prevent bi-metallic corrosion.
4. Fixing equipment: Fix independently of any other systems installation with zinc electroplated fasteners indoors and stainless steel fasteners outdoors.
5. Orientation: Accurate and square to vertical and horizontal axes. Align adjacent items of switchgear on the same horizontal axis.
6. Cable installation
   6.1. Timing: Complete installation of d.c. cabling before connecting to PV array.
   6.2. Routes and arrangement: Minimize length of d.c. cable runs.
7. Cable terminations: Label string cables with push-on plastics markers showing unique circuit reference.

Ss_70_10_70/630 Installing PV module arrays

1. General requirements: Ss_70_10_70/620 Installing photovoltaic systems generally
2. Fixings: Minimum of four clamps per module, placed symmetrically. Suitable for wind loading.
3. PV modules

3.1. Layout: Contractor's design

3.2. Mounting: Allow adequate ventilation between building fabric and underside of PV module.

3.3. Electrical connection: Interconnect between PV modules using integrated connection cables, connector plugs and string cables to form an array consisting of two strings, each string consisting of four modules.

4. Interconnecting string cable routes: Contractor's design

Ss_70_10_70/660 Installing d.c. isolation switches

1. Position: Conveniently accessible for operation inspection and maintenance.

Ss_70_10_70/690 Installing a.c. isolation switches

1. Position: Next to point of connection to a.c. grid.

Ss_70_10_70/730 Installing energy meters

1. Position: Adjacent to PV inverter and feeding distribution board.
2. Meters to show: a.c. energy exported from the array. a.c. output of complete PV system.
3. Digital metering equipment: Contractor's design

Ss_70_10_70/740 Connection to electricity distribution network

1. Interconnection: Connect into a separate dedicated circuit.

Ss_70_10_70/750 Earthing and equipotential bonding

1. Standards: In accordance with BS 7671 and BS 7430.

Ss_70_10_70/760 Connection to lightning protection system

1. Standards: To BS EN 62305-3 and BS EN 62305-4.

Ss_70_10_70/770 Labelling

1. Dual supply warning notices (grid connected systems only)
   1.1. Requirement: Provide danger warning notices stating that the system has a dual supply and is energized from more than one source.
   1.2. Position: Electricity supplier’s meter. At distribution board to which output from power conditioning unit is to be connected. PV a.c. isolation switch.
   1.3. Electricity Distributor’s approval of text: Obtain.
2. PV modules: 'Danger, do not disconnect under load. Isolate a.c. supply first'. Label with warning notices describing the presence of live terminals.
3. Connectors: Label with notices stating 'Do not disconnect d.c. plugs and sockets under load - turn off a.c. supply first'.
4. d.c. switch disconnector: 'PV array d.c. isolator- Danger - contains live parts during daylight'.
5. d.c. junction boxes: Label with notices stating 'PV array d.c. junction box - Danger, contains live parts during daylight'.
6. Power conditioning units (PCUs): Label with notices stating 'Isolate a.c. and d.c. before carrying out work'.
7. a.c. isolation switches: Label with notices stating 'PV system - main a.c. isolator'.
8. Circuit diagram: Provide at point of interconnection to a.c. distribution board.
9. Details of protective settings incorporated in the PCU: Provide at PCU.
10. Contact telephone number for the maintainer of the system: Provide at point of PCU.
11. Fuses, terminal blocks and other assembly components: Label, describing their purpose.

12. Spare fuses: Label, describing their rating and purpose.

System completion

Ss_70_10_70/810 Testing and commissioning photovoltaic systems

1. Standards: In accordance with BS 7671. To BS EN 62446-1. In accordance with EREC G99.
2. Notice before commencing tests (minimum): As per Document Section 2 Preliminaries
3. Witnessing of testing and commissioning: Required.
4. Approval: Obtain written approval of the Distribution Network Operator.
5. Specialist commissioning engineer: System manufacturer.

Ss_70_10_70/820 Documentation

1. Operating and maintenance instructions
   1.1. Scope: Submit for the system giving optimum settings for controls.
   1.2. Product information: Include product description, date of purchase, performance characteristics, application (suitability for use), method of operation and control, and cleaning and maintenance requirements.
   1.3. Format: Paper copy.
   1.4. Number of copies: As per Document Section 2 Preliminaries
2. Record drawings
   2.1. Content: As per Document Section 2 Preliminaries
   2.2. Format: As per Document Section 2 Preliminaries
   2.3. Number of copies: As per Document Section 2 Preliminaries
3. Submittal date: At handover.
4. Site test results and system performance analysis: Submit.
5. Test equipment calibration certificates: Submit.
6. System commissioning completion certificate: Submit.
7. Approval of Electricity Distributor (grid connected systems only): Submit.
8. Warranty for system: Submit.
9. Microgeneration Certification Scheme: Submit certificate.

Ω End of System

Ss_70_30_25_25
Earthing and bonding systems

Systems

Ss_70_30_25_25 Earthing and bonding systems

1. Description:

   The Contractor shall be responsible for the detailed design, supply, installation, testing and commissioning of the complete earthing system for the site, in accordance with the IET Wiring Regulation and the British Standards.

   All distribution circuits from the consumer's terminals on the main switchboard shall have a separate neutral and earth.

   The Contractor shall be responsible for ensuring that the complete system of conduit, trunking etc., together with all accessories shall have sufficient metallic connection to ensure earth continuity throughout the entire installation.
2. System performance: Ss_70_30_25/210 Design of earthing and bonding systems
3. Main incoming earth: Establish with the Electricity Distributor.
4. Main earth electrode type: Contractor's design
5. Main protective bonding conductors: Pr_65_70_48_75 Single core non-sheathed (LHSF) insulated cables
6. Supplementary bonding conductors: Pr_65_70_48_75 Single core non-sheathed (LHSF) insulated cables
7. Circuit protective conductors: Core of cable.
8. Accessories: Contractor's design
9. Electrical identification: Pr_40_10_27_27 Electrical shock treatment signs
10. Execution: Ss_70_30_25/630 General installation; Ss_70_30_25/670 Installing main protective bonding conductors; Ss_70_30_25/720 Notices and labels
11. System completion: Ss_70_30_25/810 Inspection and testing

System performance

Ss_70_30_25/210 Design of earthing and bonding systems

1. Standards: In accordance with BS 7671 and BS 7430.
2. Design: Complete the design of the earthing and bonding systems.
3. Earthing conductor: Size in accordance with BS 7671, Regulation 543.1.3.
4. Main protective bonding conductors
   - 4.1. Connect the following to the main earthing terminal: Including but not limited to (and where appropriate), Structural Framework, Lightning Protection, PV array, Electrical Installation
   - 4.2. Size (minimum): In accordance with BS 7671, Regulation 544.1.1.
5. Supplementary bonding conductors
   - 5.1. Bond the following: Where required in line with BS 7671 latest edition
   - 5.2. Size (minimum): Minimum of 2.5 mm² if sheathed or where mechanical protection is provided, otherwise 4 mm².
6. Circuit protective conductors: Size in accordance with BS 7671, Regulation 543.1.3.
7. Requirement: Submit proposals including detailed design drawings, technical information, calculations and manufacturers' literature.

Products

Pr_40_10_27_27 Electrical shock treatment signs

1. Description: To be provided at principle distribution points.
2. Manufacturer: Contractor's choice
3. Format: Plastics encapsulated.
4. Content: Text and images.
5. Size: Minimum A3
6. Geometric shape: Rectangular horizontally.
7. Colours: Full colour.

Pr_65_70_48_75 Single core non-sheathed (LHSF) insulated cables

1. Manufacturer: Contractor's choice
2. Standards: To BS EN 50525-1 and BS EN 50525-3-41.
3. Third-party certification: British Approvals Service for Cables (BASEC) certified.
4. Cable type: Contractors design
5. Size: Contractors design
6. Execution: Pr_65_70_48/660 Installing low voltage cables in conduit and trunking; Pr_65_70_48/635 Installing low voltage cables

Execution

Pr_65_70_48/635 Installing low voltage cables

1. Standard: In accordance with BS 7671.
2. Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
3. Preparation: Store cables above 5°C for 24 hours before installation.

   Clear cable path of debris.
4. Installation temperature (minimum): 5°C.
5. Cables: Install in one length. Dress cables flat, free from twists, kinks and strain.
6. Cable pulling: Do not overstress. Prevent kinks and twisting of the cable.
7. Cable protection: Cables passing through walls and floors to be sleeved with conduit or pipeduct to a minimum of 300 mm. Bush at both ends. Ensure that appropriate fire stopping materials are used to maintain the original fire integrity of the wall or floor around the penetration.
8. Concealed cable runs to wall accessories: Run vertically from the accessory.
9. Exposed cable runs: Direct to surface.
10. Distance from other services running parallel (minimum): 150 mm. Position cables below heating pipes.
11. Jointing and termination
    - 11.1. Final circuit cables: At electrical accessories only.
    - 11.2. Core connections: Using compression lugs to equipment without integral clamping terminals.
    - 11.3. Terminating cables when not using glands: Take sheathing of cables into accessory boxes and equipment and protect against abrasion with grommets.

Pr_65_70_48/660 Installing low voltage cables in conduit and trunking

1. Cable installation: Orderly and capable of being withdrawn.
2. Single core wiring: Arrange using the loop-in method.

3. Cables within trunking: Tie at 2 m intervals for cables of the same circuit reference. Label ties with circuit reference number at 10 m intervals.
4. Cables in vertical conduit: Provide cable clamps in accessible conduit boxes at 5 m intervals.
5. Extra-low-voltage cables: Install within a separate partition from low-voltage cables where installed in multi compartment trunking.

Ss_70_30_25/630 General installation

1. Standards: In accordance with BS 7430 and BS 7671.

Ss_70_30_25/670 Installing main protective bonding conductors

1. Separate and continuous connections: Install between each service and the main earth terminal.
2. Bonding conductor routes: Contractor's choice
3. Bonding connections at main earth terminal: Connect with compression lugs and phosphor bronze nuts and bolts and spring washers.

Ss_70_30_25/720 Notices and labels

1. Earth bars: Describe each connection and label with 'SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE'.
2. Earthing and main protective bonding connections: Describe each connection and label with 'SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE'.
3. Supplementary bonding connections: Describe each connection and label with 'SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE'.
4. Telecommunications functional earth connections: Label with 'TELECOMMS EARTH – DO NOT REMOVE'.
5. Earth free locations: For areas utilizing protection by earth-free local equipotential bonding label with ‘THE PROTECTIVE BONDING CONDUCTORS ASSOCIATED WITH THE ELECTRICAL INSTALLATION IN THIS LOCATION MUST NOT BE CONNECTED TO EARTH – EQUIPMENT HAVING EXPOSED-CONDUCTIVE-PARTS CONNECTED TO EARTH MUST NOT BE BROUGHT INTO THIS LOCATION’.

System completion

Ss_70_30_25/810 Inspection and testing

1. Standards: In accordance with BS 7430 and BS 7671.
2. Notice before commencing tests (minimum): As Specification Volume 2 Preliminaries
3. Continuity of protective conductors
   - 3.1. Parallel earth paths: Isolate before testing.
   - 3.2. Equipment: Continuity tester with short circuit current not less than 200 mA, and a no load d.c. or a.c. voltage between 4 V and 24 V.
4. External earth fault loop impedance (Ze): Direct measurement.
5. Earth fault loop impedance (Zs): Direct measurement.

Ω End of System

Ss_70_30_45_40
Low-voltage site connection systems

Systems

Ss_70_30_45_40 Low-voltage site connection systems

1. Description:

   The Contractor shall undertake the detailed design, supply, installation, testing and commissioning of the incoming low voltage system in compliance with utility provider regulations. The Contractor shall be be required to liaise with any meter providers, to ensure that proposed meter positions, access arrangements and requirements are provided in accordance with their recommendations and standards.

   The Contractor shall note the following for information only:

   - The site is currently served via an existing UK Power Networks substation located on the site boundary in the north corner adjacent to Unit 29, though the size/capacity of the transformer is unknown.
   - The substation serves a walk in GRP kiosk adjacent with 3no 400A TP&N supplies terminating in 400A Heavy Duty Cut-Outs.
   - Each cut-out serves a 400A TP&N main isolation switch, spreader box, and then out via buried sub-main to external.
   - The three primary supplies then distribute around the site, with tap-offs serving each of the 28no units.
   - This is different to the expected principle supply and MCCB panel board arrangement and therefore, the existing system is not suitable to tap into.

   Part of the Contractors remit shall be to liaise with UK Power Networks to establish how best to export the electricity generated by the PV arrays and whether the on-site substation can be used to accommodate this.

   Should a new off-site connection be required, or if connection into the existing substation is possible, the Contractor shall allow for all trenching and ducting as required by the utility provider.

2. System performance: Ss_70_30_45/210 Design of incoming low voltage electricity supply
3. Nature of current: Alternating.
4. Phase: Three phase 4 wire.
5. Voltage: 400 V.
6. Electricity distributor: UK Power Networks via Independent Connections Provider
7. Electricity supplier: Client to confirm
8. Metering: Single export utility meter to point of final connection.
9. Execution: Ss_70_30_45/640 Location of incoming point of supply; Ss_70_30_45/660 Earthing arrangement
10. System completion: Ss_70_30_45/810 Site supply characteristics; Ss_70_30_45/820 Phase sequence; Ss_70_30_45/830 Documentation

System performance

Ss_70_30_45/210 Design of incoming low voltage electricity supply

1. Standards: In accordance with BS 7671 and the Electricity Distributor's guidelines.

2. Design: Complete the design of the low voltage supply.
3. Evidence of agreement with Electricity Distributor: Submit.

Execution

Ss_70_30_45/640 Location of incoming point of supply

1. Incoming point of supply: Coordinate the location and establish the spatial requirements for the Electricity Distributor's equipment and metering.
2. Location and colour coding of equipment: In accordance with NJUG guidelines on the positioning of underground apparatus for new development sites. Volume 2.

Ss_70_30_45/660 Earthing arrangement

1. Incoming earthing arrangement: Establish with the Electricity Distributor.

System completion

Ss_70_30_45/810 Site supply characteristics

1. Prospective short-circuit current (Pscc): Measure and submit results.
2. External earth fault loop impedance (Ze): Measure and submit results.

Ss_70_30_45/820 Phase sequence

1. Phase sequence: Verify.
2. Means of identification: Describe within the operation and maintenance manual.

Ss_70_30_45/830 Documentation

1. Operating and maintenance instructions
    1.1. Format: Paper copy.
    1.2. Number of copies: As per Document Section 2 Preliminaries
2. Record drawings
    2.1. Content: As per Document Section 2 Preliminaries
    2.2. Drawing format: As per Document Section 2 Preliminaries
    2.3. Number of copies: As per Document Section 2 Preliminaries
3. Submittal date: At handover.

Ω End of System

Ss_70_30_45_45
Low-voltage distribution systems

Systems

Ss_70_30_45_45 Low-voltage distribution systems

1. Description:

The Building Services Contractor shall carry out the detailed design, supply, installation, testing and commissioning of the mains power distribution system, inclusive of all cabling, distribution boards and circuit protective devices as shown on the drawings and in accordance with the latest British Standards.

The system shall comprise of main isolation switch at the point of connection to the supply authority LV network. This in turn shall serve a 1200/1600A TP&N MCCB panel board which shall act as the main collection point for all of the array/inverter supplies distributing from across the site. MCCB devices shall be sized according to the size of output for the connected inverter/PV array.

The cabling for this shall distribute across the site in buried service ducts, via draw pits. An indicative principle distribution schematic has been provided for reference, provided to assist with Tendering only, and this should be read in conjunction with the indicative site layout plan.

Cabling should be run within duct, in XLPE/SWA cabling, with draw pits using the Cubis Systems Stakka box products. Indicative locations have been shown for draw pits on the site layout drawing, but the Contractor shall verify all sizes, positions and quantities as part of their detailed design.

For the purposes of this section, the LV distribution system shall comprise of the following:

- Main isolation switch;
- MCCB panel board and associated devices;
- LV distribution cabling from the main isolation switch until the AC isolators for the PV inverters;
- All GRP cabinets (by Enclosure-Tec), including concrete plinth bases;
- All below ground ducting and draw pits by Cubis Systems Stakka Box range;
- Signage and warning notices;

General

All submain cabling shall be XLPE/LS0H/SWA as noted above, suitably sized and arranged in a neat formation where above ground, with the necessary spacing and supports as stipulated in the IET wiring regulations (latest edition) unless otherwise noted.

Service runs shall be run within the soft landscaping where possible to minimise works to finished surfaces. Where there is not possible, the Contractor shall liaise with the Landlord to establish programme of works and any permits that may be required. Most notably, this shall be for carriageway crossings, particularly around the site entrance where out of hours working may be required.

The Contractor shall install cable identification at each terminating end of the sub-main cabling.

The Contractor shall supply and install a Type 1&2 SPD (Surge protective device) to the main incoming supply prior to the service entering the main MCCB panel board. Further surge protection shall be provided to each inverter location with the GRP kiosks.

All cabling calculations for the LV distribution system shall be undertaken on industry standard software such as Amtech all in accordance with BS 7671.

2. System performance: Ss_70_30_45/215 Low voltage distribution circuit cables generally; Ss_70_30_45/221 Selection of conduit, trunking and ducting
3. Connection to low-voltage supply: At incoming service head
4. Distribution circuit cabling: Pr_65_70_48_90 Thermosetting insulated and thermoplastic sheathed (LSHF) armoured cables
5. Cable accessories: Pr_65_70_11_13 Cable cleats; Pr_65_70_11_15 Cable ties
6. Containment: Pr_65_70_11_17 Cable trays; Pr_65_70_11_71 Rigid conduit
7. Containment accessories: Contractor's design
8. Rewireable installation: Required.
9. Concealed installation: Required.
10. Electrical identification: Pr_40_10_27_24 Electrical diagrams; Pr_40_10_27_27 Electrical shock treatment signs; Pr_40_10_57_29 Equipment labels and warning notices
11. Execution: Ss_70_30_45/625 Installing low voltage distribution systems; Ss_70_30_45/650 Connection to the incoming supply
12. System completion: Ss_70_30_45/811 Inspecting, testing and commissioning of switchgear generally; Ss_70_30_45/821 Documentation

System performance

Ss_70_30_45/215 Low voltage distribution circuit cables generally

1. Proposed selection of low-voltage distribution cables: Submit drawings, technical information, calculations and manufacturers' literature.
2. Conductor sizes (minimum): Contractor design
3. Cable sizes not stated: Submit.
4. Format: Amtech.

Ss_70_30_45/221 Selection of conduit, trunking and ducting

1. Standard: In accordance with BS 7671.
2. Requirement: Submit proposals including detailed design drawings, technical information, calculations and manufacturers' literature.
3. Conduit, trunking and ducting sizes not stated: Submit.

Products

Pr_40_10_27_24 Electrical diagrams

1. Description: At principle distribution points
2. Material: Paper print, encapsulated.
3. Format: Single line engineering drawings to BS EN 61082-1.
4. Information to be included: Supply characteristics. Cable types and sizes. Switchgear ratings. Protective device types, ratings and function.
5. Size: A1.

Pr_40_10_27_27 Electrical shock treatment signs

1. Description: To be provided at principle distribution points.
2. Manufacturer: Contractor's choice

3. Format: Plastics encapsulated.
4. Content: Text and images.
5. Size: Minimum A3
6. Geometric shape: Rectangular horizontally.
7. Colours: Full colour.

Pr_40_10_57_29 Equipment labels and warning notices

1. Description: On all items of electrical distribution equipment with phase, voltage and equipment reference.
2. Manufacturer: Contractor's choice
3. Material: Face engraved rigid plastic laminate.
4. Label size: Contractor's choice
5. Colour
   5.1. Background: White.
   5.2. Lettering: Black.
6. Typography
   6.1. Font: Helvetica medium
   6.2. Size: Contractor's choice
7. Notice wording: Board reference, as indicated on power drawings.

Pr_65_70_11_13 Cable cleats

1. Manufacturer: Contractor's choice
2. Standard: To BS EN 61914.
3. Format: Contractor's choice
4. Material: Metallic.
5. Temperatures for permanent installation
   5.1. Maximum: 60°C.
   5.2. Minimum: -5°C.
6. Environmental influences
   6.1. Non-metallic and composite components: Resistant to ultraviolet light.
   6.2. Metallic and composite components: High resistance to corrosion.

Pr_65_70_11_15 Cable ties

1. Manufacturer: Contractor's choice
2. Standard: To BS EN IEC 62275.
3. Format: Wrap around self-locking non-releasable.
4. Material: Metal.
5. Temperatures for permanent installation
   5.1. Maximum: 60°C.
   5.2. Minimum: -5°C.
6. Contribution to fire : Non-flame propagating.
7. Environmental influences
   7.1. Non-metallic and composite components: Resistant to ultraviolet light.
   7.2. Metallic and composite components: Resistant to corrosion.

Pr_65_70_11_17 Cable trays

1. Description: Refer to containment drawings for cable tray routes and size
2. Manufacturer: Contractor's choice
3. Standard: To BS EN 61537.
4. Material: Metal.
5. Resistance against flame propagation: Non-flame propagating.
6. Electrical properties
   6.1. Continuity characteristics: With electrical continuity.
7. Coating material: Hot dip galvanized.
8. Temperature properties for transport, storage, installation and application
   8.1. Minimum: -5°C.
   8.2. Maximum: 60°C.
9. Mechanical properties
10. Width: Refer to containment drawings for cable tray routes and size
11. Execution: Pr_65_70_11/621 Installing cable tray and cable ladder

Pr_65_70_11_71 Rigid conduit

1. Description: Rigid conduit to be used in final connections to equipment. Where run externally, all rigid conduit to be in galvanised steel with galvanised clips and fixings.
2. Manufacturer: Contractor's choice
3. Standards: To BS EN 61386-1 and BS EN 61386-21.
4. Mechanical properties
   4.1. Resistance to compression: Medium.
   4.2. Resistance to impact: Medium.
5. Transport, installation and application
   5.1. Lower temperature (minimum): -5°C.
   5.2. Upper temperature (maximum): 90°C.
6. Resistance to bending: Rigid.
7. Electrical characteristics: With electrical continuity properties.
8. Resistance to external influences
   8.1. Protection against ingress of solid objects (minimum): To BS EN 60529, IP3X.
   8.2. Protection against ingress of water (minimum): To BS EN 60529, IPX0.
9. Resistance to corrosion: High protection, inside and outside.
10. Tensile strength: Light.
11. Resistance to flame propagation: Non-flame propagating.
12. Colour: Standard finish
13. Sizes (OD): To suit installation - final containment, fixings and bracketry part of CDP elements.
14. Execution: Pr_65_70_11/721 Installing rigid metallic conduit

Pr_65_70_48_90 Thermosetting insulated and thermoplastic sheathed (LSHF) armoured cables

1. Manufacturer: Contractor's choice
2. Standard: To BS 6724.
3. Third-party certification: British Approvals Service for Cables (BASEC) certified.
4. Size: As per PV specialist design

5. Insulation: As per PV specialist design
6. Sheath colour: Black.
7. Reaction to fire class
   7.1. Fire behaviour: C_{ca}.
   7.2. Additional classification for smoke production: s1b.
   7.3. Additional classification for flaming droplets and/ or particles: d2.
   7.4. Additional classification for acidity: a2.
8. Execution: Pr_65_70_48/680 Installing low voltage armoured cables

Execution

Pr_65_70_11/621 Installing cable tray and cable ladder

1. Standards: In accordance with BS 7671 and IET Guidance Note 1.
2. Preparation
   2.1. Burrs and sharp edges: Make smooth.
   2.2. Cutting: Minimize and make good edges. Cuts to cable tray to be square along an unperforated line.
   2.3. Treatment of cut surface: Extend 25 mm beyond the cut. Match finish of cable supports.
3. Access: Provide space around cable ladder and tray to permit access for installing and maintaining cables.
4. Joints and expansion couplers
   4.1. Position: Locate between the bracket support and the quarter point.
   4.2. Number of joints: Minimize.
   4.3. Lengths of cable ladder and tray: Maximize.
   4.4. Ends: Blank with end plates.
5. Changes of size and direction: Manufacturer's accessories of the same material type, pattern, finish and thickness as cable supports.
6. Fire barriers: Provide where required to maintain fire performance of fabric.
7. Protective covers: Provide to cables requiring mechanical protection.
8. Support
   8.1. Clearance from building fabric (minimum): 20 mm.
9. Components: Avoid contact between dissimilar metals.
10. Routing of cable ladder and tray: Submit drawings showing the proposed routes of cable ladder and cable tray.

Pr_65_70_11/721 Installing rigid metallic conduit

1. General requirements: To be used in all high risk areas or where additional mechanical protection is required.
2. Fixings: Saddle.
3. Joints: Screwed.
4. Threaded conduits: Tightly screw to ensure electrical continuity, with no thread showing.
5. Conduit connections to boxes and items of equipment, other than those with threaded entries: Earthing coupling with male brass bush and protective conductor.

Pr_65_70_48/635 Installing low voltage cables

1. Standard: In accordance with BS 7671.
2. Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.

3. Preparation: Store cables above 5°C for 24 hours before installation.

   Clear cable path of debris.
4. Installation temperature (minimum): 5°C.
5. Cables: Install in one length. Dress cables flat, free from twists, kinks and strain.
6. Cable pulling: Do not overstress. Prevent kinks and twisting of the cable.
7. Cable protection: Cables passing through walls and floors to be sleeved with conduit or pipeduct to a minimum of 300 mm. Bush at both ends. Ensure that appropriate fire stopping materials are used to maintain the original fire integrity of the wall or floor around the penetration.
8. Concealed cable runs to wall accessories: Run vertically from the accessory.
9. Exposed cable runs: Direct to surface.
10. Distance from other services running parallel (minimum): 150 mm. Position cables below heating pipes.
11. Jointing and termination
    11.1. Final circuit cables: At electrical accessories only.
    11.2. Core connections: Using compression lugs to equipment without integral clamping terminals.
    11.3. Terminating cables when not using glands: Take sheathing of cables into accessory boxes and equipment and protect against abrasion with grommets.

Pr_65_70_48/680 Installing low voltage armoured cables

1. General requirements: Pr_65_70_48/635 Installing low voltage cables; Pr_65_70_48/685 Jointing and terminating low voltage armoured cables
2. Earthing: Bond armour to equipment and main earthing system.
3. Connections to apparatus: Moisture proof, sealed glands and shrouds.

Pr_65_70_48/685 Jointing and terminating low voltage armoured cables

1. Preparation
    1.1. Cable ends: Cut immediately before jointing or terminating.
    1.2. Cables left unconnected for more than 24 h: Seal to prevent moisture ingress.
2. Cable stripping
    2.1. Length of exposed cores and conductors: Minimize. Leave no exposed conductor after termination.
    2.2. Strands: Do not damage when stripping cable cores. Twist together. Do not reduce number. Secure at terminations.
3. Joints and terminations: Use qualified cable jointers, using jointing materials, components and installation techniques recommended by the cable manufacturer and the jointing accessory manufacturer.
4. Tooling certificate: Submit before installing connectors.
5. Cable glands: To BS EN 62444 and fitted with shroud.
6. Cold pour resin and heat shrink joints: To BS EN 50393.
7. Insulating tape: To BS EN 60454-1.
8. Plastics sheathed cables: Seal with proprietary shrink-on end caps.
9. Bolted terminal connections to equipment and switchgear without integral cable clamping terminals: Compression type lugs, of correct bore.
10. Compression joints: Provide in accordance with BS 7609.
11. Conductor labelling: Identify cable conductor cores at each end of cable and at joints.
12. Unused cable cores: Connect to earth.

Ss_70_30_45/625 Installing low voltage distribution systems

1. Standard: In accordance with BS 7671.
2. Layout: Position cabling and equipment to provide safe and easy access for operation and maintenance.

Ss_70_30_45/650 Connection to the incoming supply

1. Customer's installation: Connect low voltage distribution to incoming supply at Electricity Distributor's incoming isolation point.

System completion

Ss_70_30_45/811 Inspecting, testing and commissioning of switchgear generally

1. Standard: In accordance with BS 7671.
2. Notice before testing and commissioning: As document Section 2 Preliminaries
3. Switches and circuit breakers: Clean to remove all visible traces of dust.
4. Protective devices settings: Configure to match the grading study.
5. Switchboard monitoring: Continuous for 30 minutes following first energizing.
6. Additional inspecting and testing: Check levelling and alignment of assembly. Check operation of instruments and metering devices. Check functional operation of circuit breakers. Check operation of switch tripping devices. Check tightness of bolted connections. Check earth connections at compartments, switches and earth electrodes. Check clearance of live parts from direct contact. Check operation of protective devices using secondary and primary current injection. Carry out earth fault protection simulation tests.
7. Testing and commissioning results: As document Section 2 Preliminaries
8. Certificates of calibration for meters and instruments: Submit.

Ss_70_30_45/821 Documentation

1. Operating and maintenance instructions
   - 1.1. Scope: Submit for the system giving optimum settings for controls.
   - 1.2. Product information: Include product description, date of purchase, performance characteristics, application (suitability for use), method of operation and control, and cleaning and maintenance requirements.
   - 1.3. Format: As document Section 2 Preliminaries
   - 1.4. Number of copies: As document Section 2 Preliminaries
2. Record drawings
   - 2.1. Content: For all low voltage distribution circuits: the cable origin, circuit designation, route, loading, conductor material and c.s.a., insulation type and colour, number of cores per cable, number of cables in trunking and conduit. Location, route and depth of underground cables. Location of LV switchgear including distribution boards. Routes of trunking, conduit, cable tray and cable ladders. Schematic drawings showing all low voltage distribution circuits: the cable origin, circuit designation, cable type, size, number of cores, size and type of overcurrent protective device.
   - 2.2. Drawing format: As document Section 2 Preliminaries
   - 2.3. Number of copies: As document Section 2 Preliminaries
3. Submittal date: At handover.

Ω End of System

Ss_75_50_45_45
Lightning protection systems

Systems

Ss_75_50_45_45 Lightning protection systems

1. Description:

   The Contractor shall be aware that the existing buildings are all protected via lightning protection systems.

   Although new systems are not required, the Contractor shall make allowance for the bonding of all new PV systems and supports to the lightning protection system at roof level.
2. System performance: Ss_75_50_45/210 Design of lightning protection systems
3. System manufacturer: A member of the Association of Technical Lightning and Access Specialists.
4. Air-termination system: To be advised by lightning protection specialist
5. Down-conductor system: To be advised by lightning protection specialist
6. Earth-termination system: To be advised by lightning protection specialist
7. Electrical identification: Pr_40_10_57_29 Equipment labels and warning notices
8. Execution: Ss_75_50_45/660 Lightning equipotential bonding; Ss_75_50_45/680 Installing notices and labels
9. System completion: Ss_75_50_45/810 Inspection and testing of lightning protection systems; Ss_75_50_45/820 Documentation

System performance

Ss_75_50_45/210 Design of lightning protection systems

1. Design: Complete the design of the lightning protection system.
2. System designer: A member of the Association of Technical Lightning and Access Specialists.
3. Standards: To BS EN 62305-1, BS EN 62305-2, BS EN 62305-3 and BS EN 62305-4.
4. Class of LPS: Class IV.
5. External LPS type: Attached to the structure (non-isolated).
6. Earth-termination system: To BS EN 62305-3, Type A.
7. Internal LPS type: Lightning equipotential bonding by direct connections, surge protective devices, and electrical insulation.
8. Requirement: Submit proposals including detailed design drawings, technical information, calculations and manufacturers' literature.

Products

Pr_40_10_57_29 Equipment labels and warning notices

1. Description: On all items of electrical distribution equipment with phase, voltage and equipment reference.
2. Manufacturer: Contractor's choice
3. Material: Face engraved rigid plastic laminate.
4. Label size: Contractor's choice
5. Colour
   5.1. Background: White.

5.2. Lettering: Black.

6. Typography
   6.1. Font: Helvetica medium
   6.2. Size: Contractor's choice
7. Notice wording: Board reference, as indicated on power drawings.

Execution

Ss_75_50_45/660 Lightning equipotential bonding

1. Standards: To BS EN 62305-3 and BS EN 62305-4.
2. Bond the following to the lightning protection system: Photovoltaic array.
3. Bonding conductor sizes: To BS EN 62305-3, Tables 8 and 9.
4. Location of bonds: Contractor's design

Ss_75_50_45/680 Installing notices and labels

1. Warning notices: Locate a warning notice adjacent to the main earthing terminal indicating that the structure is provided with a LPS and bonding to other services and the main earth terminal should be terminated accordingly.

System completion

Ss_75_50_45/810 Inspection and testing of lightning protection systems

1. Standards: To BS EN 62305-3 and BS EN 62305-4.
2. Results: Include within inspection guide.

Ss_75_50_45/820 Documentation

1. Standards: To BS EN 62305-3 and BS EN 62305-4.
2. Inspection guide
   2.1. Submit including the following information: Earth resistance measurements of the earth-termination system. The result of any measurements performed.
   2.2. Format: A4 paper print. Electronic.
   2.3. Number of copies: As Document Schedule 2 Preliminaries
3. Record drawings
   3.1. Content: As Document Schedule 2 Preliminaries
   3.2. Format: As Document Schedule 2 Preliminaries
   3.3. Number of copies: As Document Schedule 2 Preliminaries
4. Submittal date: As Document Schedule 2 Preliminaries

Ω End of System

Ac_70_60_49/110
Low voltage electrical installation testing and inspecting

Activities

Ac_70_60_49/110 Low voltage electrical installation testing and inspecting

1. Description: The Contractor shall undertake the complete inspection and testing of the low voltage electrical installations within the buildings as detailed below.
2. General requirements
   2.1. Electrical test engineer: Electrical installation contractor.
   2.2. Approval: National Inspection Council for Electrical Installation Contracting (NICEIC).
   2.3. Evidence of approval: Submit.
   2.4. Test equipment calibration: UKAS approved.
3. Execution: Ac_70_60_49/610 Test equipment calibration; Ac_70_60_49/620 Inspection and testing electrical installations generally
4. System completion:

Execution

Ac_70_60_49/610 Test equipment calibration

1. Description: Must be within last calibration time period.
2. Test equipment calibration: UKAS approved.

Ac_70_60_49/620 Inspection and testing electrical installations generally

1. Description: All inspection and testing to be undertaken in accordance with the standards set out below.
2. Standards: In accordance with BS 7671 and IET Guidance Note 3.
3. Notice before commencing tests (minimum): As Document Schedule 2 Preliminaries
4. Installed equipment standards: Verify and confirm compliance with the relevant equipment standards.
5. Electronic devices: Isolate to prevent damage during testing.
6. Continuity of protective conductors
   6.1. Parallel earth paths: Isolate before testing.
   6.2. Equipment: Continuity tester with short circuit current of at least 200 mA, and a no load d.c. or a.c. voltage between 4 V and 24 V.
7. Insulation resistance (minimum)
   7.1. SELV and PELV circuits: 1 megohm when tested at 250 V d.c.
   7.2. Other circuits less than or equal to 500 V (excluding SELV and PELV): 2 megohm when tested at 500 V d.c.
   7.3. Circuits above 500 V: 2 megohm when tested at 1000 V d.c.
8. External earth fault loop impedance (Ze): Direct measurement.
9. Earth fault loop impedance (Zs): By direct measurement.
10. Measurement locations: Origin, switchgear, fixed equipment and outlets, circuit extremities.
11. Prospective fault current
    11.1. Method: Direct measurement.
    11.2. Location: Origin, and at points where protective devices are required to operate under fault conditions.

12. Phase sequence: Verify.
13. Cable containment: Measure electrical continuity and insulating properties of containment. Submit results.

Ω End of Activity

Specification created using NBS Chorus