REAL ESTATE INVESTMENT PARTNERSHIPS

Electrical Performance Specification

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1 Definitions

In applying the Specification the following words shall have the meanings herein assigned to them unless there is something the subject matter of context inconsistent with such construction.

“EMPLOYER” shall mean the Person, Persons, Company, Authority and their Representatives who are named in the main contract.

“ENGINEER” shall mean the person representing the Building Services Consultant.

“MAIN CONTRACTOR” shall mean the Person, Firm or Company undertaking the Main Contract and shall include their successors, heirs, executors and administrators named as a party to the Main Contract and the Contractor.

“MeC” shall mean the Person, Firm or Company undertaking the Mechanical Works.

“EleC” shall mean the Person, Firm or Company whose quotation for specialist Electrical Engineering Works forming the subject of this Specification has been accepted and who has entered into a Sub-Contract with the Main Contractor and shall include their or their successors, heirs, executors and administrators.

“SPECIFICATION” shall mean the Specification on which the Tender is based.

“MATERIALS” shall mean all plant, materials and equipment for incorporation in the works.

“WORKS” shall mean and include all materials to be used and work to be done by the Contractor under the Contract and shall include supplying, fixing, testing, regulating and commissioning of the installations described in the specification.

“EMPLOYERS AGENT (EA)” shall mean the person appointed by the Employer responsible for the administering of the Main Contract (Architect).

“PLANNING SUPERVISOR” shall mean the person appointed by the Employer (or others) to act as Planning Supervisor in accordance with the Construction, Design & Management Regulations 1994 and any subsequent amendments to same.

“SITE” shall mean the actual place or places to which the materials shall be delivered to where work shall be done by the Contractor, together with so much of the area surrounding the said place, or places, as the Contractor shall actually use in connection with the Works as otherwise than merely for the purpose of access to the said place or places.

“WRITING” shall mean any manuscript, typewritten or printed statement under seal or hand as the case may be.

“SHALL” shall mean mandatory.

“DATE OF TENDER” shall mean the date nominated in the enquiry document for the return of tenders.

"BRITISH STANDARD SPECIFICATION" The term "BSS" or "BS" shall mean British Standard Specification, current edition.

"OTHER DEFINITIONS" OR "EXPRESSIONS" shall have the meanings respective assigned to them in the Main Contract and Sub-Contract Terms and Conditions. Words importing persons include Firms and Corporations.
Words importing the singular only also include the plural and vice versa where the context requires.

The terms "APPROVED" and "DIRECTED" herein shall mean approved and directed in writing by the Contract Administrator.

2 Tender Contract Drawings

The drawings provided as part of the enquiry documentation shall be treated as confidential documents and must not be loaned or copied to any other party without the express permission of the Engineer.

The drawings provided (together with this Specification) are intended to provide sufficient information to enable tenderers to provide a quotation for the required work and provide the basis for working drawings. Not all items or matters referred to in the Specification are indicated on the drawings and similarly not all items detailed on the drawings are described in the Specification.

It is the responsibility of the tenderer for all materials, items of equipment, etc. necessary to provide a complete finished installation as intended and for minor offsetting and alteration of service runs to achieve co-ordination with the building and other services/equipment, etc.

The tenderer shall, upon request, be provided access to all available relevant project drawings.

Claims for additional payment for alterations or additions to the works brought about by conflict between the works and building detail or other services, will not be considered and the MeC shall fully liaise with the main contractor and/or other sub-contractors as necessary.

Unless previously advised by the Engineer the tender drawings are not intended for use as working drawings.

3 Working Drawings

The EleC shall provide and prepare a full set of working drawings. The drawings shall be to a scale not less than the tender drawings. The working drawings shall be used to enable installation of the works and to enable other Contractors to produce co-ordinated working details.

Dimensions shall be taken from site measurements only.

The drawings shall be fully co-ordinated with building detail and all other services.
The EleC shall, through the Main Contractor provide duplicate copies of all drawings for the Architect, other Service Contractors, Structural Engineer and Engineer prior to the

commencement of work or fabrication commences. The Engineer will require at least 5 working days to comment on the proposals. No works will be installed from drawings that have not been commented on by the Engineer or Design Team.

The EleC shall be fully responsible for any errors in these drawings whether or not approved by the Engineer. No additional costs will be payable as a result of error or as a result of lack of co-ordination between building detail and drawings or between services, and, in addition, all costs resulting from disruption to other trades as a result of error or oversight shall be borne by the EleC.

The tender documents are not intended for use as working drawings. The EleC shall take full responsibility for all details shown on the final working drawings.

A full set of drawings shall be kept on site in order that a record of all service runs, and changes to the working drawings can be maintained. These drawings shall form the basis for the "As Fitted" drawings.

4 As Fitted Drawings

The EleC shall maintain on site, a record of all changes to the tender scheme as works proceed so that "As Fitted" drawings can be produced immediately after the installation has been completed.

The EleC shall produce the "As Fitted" drawings, which shall be based on the tender drawings and shall be equal in quality to the tender drawings.

The drawings shall include all relevant information and shall exclude any information that is relevant only during tender and construction. Each drawing shall be clearly labelled "As Fitted Drawing" and shall bear the Elec's title block.

The Engineer shall stipulate whether "As Fitted" drawings shall be produced on CAD. Full allowance shall be made for this facility if required and specified. The format of the CAD drawings specified shall be strictly adhered to.

Late production of the "As Fitted" Drawings will delay the issue of the Practical Completion Certificate and Final Account Payment.

(See clause for Handover Procedures).

The EleC shall notify the Main Contractor and the EA in writing if for any reason they are unable to complete the "As Fitted" drawings on time for the handover meeting. The EA will then advise the Main Contractor either that the "As Fitted" drawings will be prepared by others and the cost of producing them deducted from any monies due or invoiced directly to the main contractor or the EleC at the sole discretion of the Employer, or (b) that the handover will be delayed until the "As Fitted" drawings have been produced by the EleC, or (c) hand over takes place and a further date is agreed for the production of as fitted drawings.

Further requirements for "As Fitted" drawings are detailed in the accompanying technical section of this specification.

5 Builders Work

The EleC shall provide all information with regard to builders work in connection with the services as and when required.

The EleC shall be responsible for establishing at the start of the contract, the nature of the information that will be required and for providing the information in whatever means that may be agreed.

Generally, all items of builders work other than chases shall be detailed on drawings provided by the EleC. The drawings shall be prepared in good time so as in no way to impair the progress of construction.

6 Liaison with Other Trades

The Main Contractor shall be responsible for co-ordinating the works of all Sub-Contractors. Under the direction of the Main Contractor, the EleC shall fully liaise with all other trades whilst preparing working drawings and whilst installing the works.

Note: The MeC and EleC shall be responsible for continual liaison during the contract period and for keeping the main contractor continually updated with information.

Before carrying out any work on, or making connections to, any plant or equipment supplied by others, the EleC shall verify the exact position and nature of the equipment on site with the appropriate Contractor or Supplier and shall take into account and accommodate positions of services and connections installed by other trades.

The EleC shall ascertain the exact position of all switches, socket outlets, radiators, etc. and to verify the positions of any fixed furniture, or special finishes, the swing of doors, tile layouts and any other such like factors which may affect the arrangement of the works. No claim for additional payment shall be entertained for abortive work where these procedures have not been carried out.

7 The Contractor To Inform Himself Fully

The EleC shall be deemed to have examined the site, the Specification, drawings and any other documents, which form part of the contract or describe the works.

In the case of an existing building, the EleC shall be responsible for visiting site to carry out a pre-tender survey, to ascertain the conditions under which the work is to be carried out, means of access, requirement for scaffolding, building structure and obtaining full particulars of any part, or parts, of the existing installation which are to be re-used or adapted and make full allowance in their tender for all such like factors.

No allowance shall be made for ignorance due to the EleC's neglect in this respect.

Where the particular specification refers to quotations from specialists/manufacturers/stockists, the references are intended for tender guidance only. The EleC is responsible for ensuring that the quantities, service or equipment, included within their offer satisfies the requirements and intents of the scheme. Any doubt in this connection must be clarified with the Engineer before tenders are submitted.

8 Conflict

Any contradiction between the Specification and drawings must be brought to the attention of the Engineer and Employer during the tender period when a ruling will be given.

A discrepancy between the Specification and drawings will not be accepted as a basis for additional payment after receipt of tenders.

If the details given in the Specification, conflict in any way with manufacturers installation instructions or the requirements of British Standards or Codes of Practice, then the relevant section of the Specification will not be adhered to. Any such conflicts shall immediately be

brought to the attention of the Engineer, who will issue guidance as to which document is to be followed.

9 Dimensions

Where plant or equipment is to be installed inside or close to buildings and structures, the EleC shall take their own dimensions of the buildings or structures for the purpose of installing any plant and materials supplied under the contract and shall be responsible for the accuracy of such dimensions. These dimensions shall be used in preference to any supplied the Engineer.

Dimensions written on drawings shall in all instances be taken in preference to those measured on a drawing to a given scale.

Any such discrepancies shall be notified to the Engineer before action is taken.

10 Connection To Appliances

The EleC shall be responsible for making all final connections to items of plant and equipment provided and installed by them, except where this is specified to be carried out by others.

The EleC shall be responsible for the satisfactory reconnection of any existing plant or equipment, which they disconnect during the course of the work.

Where specified, the EleC shall also fix and/or connect items of plant and equipment supplied by others.

11 Ease Of Maintenance

In positioning all plant and equipment, the EleC shall at all times give proper consideration to the future maintenance of the plant and shall include for such component parts as are available from the manufacturer of the equipment or plant, to ensure ease of maintenance.

12 Samples For Employers Approval

The EleC shall submit to the Employer, for approval, such samples of the workmanship, materials or equipment that the EleC proposes to use in the execution of the works as the EA shall require.

Where, in the opinion of the Engineer, the samples submitted are not of a sufficiently high standard or are unsuitable for use in the proposed circumstances, they shall have the right to instruct the EleC to obtain alternative materials or equipment from such a source as the Engineer shall decide.

All expenditure in connection with providing samples for approval shall be borne by the EleC.

13 Interference Suppression Of Contractors Equipment

All equipment used by the EleC for the erection of the works shall be suppressed to comply with current British Standards, so as to cause no interference with radio, television or electromechanical apparatus.

14 Supervision

The EleC must, during the construction of the works, engage a competent foreman on site to supervise the work, whose identity shall not be changed without the written agreement of the EA.

The foreman must be capable of taking decisions and receiving instructions, which are binding on the EleC.

15 Specialist Trades Attendance On Equipment

The EleC shall arrange and make all payments for specialist tradesmen to visit the site, adjust and put into working order, all items of specialist plant and equipment, as detailed in the Specification.

16 Noise And Vibration

The EleC shall be fully responsible for ensuring the reasonably silent operation of any running machinery installed by them under this contract and shall make all necessary allowances for fitments required to effectively damp out and insulate noise and vibration from causing any annoyance to the occupants of the building or adjacent premises.

When work is undertaken within occupied buildings, or in the vicinity thereof, the EleC shall so arrange this work that the minimum amount of noise and inconvenience is caused to the occupants of the buildings.

Noisy mechanical equipment shall only be permitted to be used by prior arrangement with the main contractor, and the EleC shall allow for executing the work accordingly.

17 Fire Hazard

The EleC shall be responsible for ensuring that proper precautions are taken to protect the building and its contents where naked flame is used in the course of the installation, commissioning or testing.

They shall ensure that fire extinguishers, fire blankets or other devices required by the local Fire Officer, are available in areas where such hazards exist.

18 Standard Of Installation

A suitably high standard of installation shall be maintained to comply with the requirements of this Specification and those of the relevant bodies, as published in the latest editions of their standard requirements and/or regulations.

For example:-

- British standards issued by the British Standards Institute
- Building Regulations
- Requirement of the Health and Safety Executive and CDM Regulations
- Regulations under the Electricity Acts issued by the Department of Energy
- Requirement of the Local Fire Officer and/or Building Control Officer
- Current IET Wiring Regulations for Electrical Installations and current amendments
- Requirements of the Local Electricity Supply Company
- Model water supply bylaw
- Requirements of the Local Water Supply Company
- Requirements of Local Gas Authority
- CIBSE recommendations
- British Gas Regulations

Any installation or parts thereof, installed by the EleC, deemed by the Engineer to be untidy, installed incorrectly, not in accordance with the above, will be removed and correctly installed to the satisfaction of the Engineer at the EleC's cost. Any subsequent costs caused by abortive builders works, making good, delay or disruption to other trades will be met by the EleC.

19 Materials

All materials and equipment shall be new unless otherwise stated in this Specification, or on the tender drawings. Where details or descriptions are given, these are for guidance only, and the EleC shall ensure that full allowance is made for all associated materials and equipment to provide a fully complete and operational installation.

Where reference is given to suppliers or manufacturers quotations, the EleC shall ensure that such quotations meet the requirements of the tender scheme with regard to both Specification and quantities and that all terms and conditions forming part of the quotations are acceptable to the EleC and that such terms and conditions will enable compliance with the tender offer.

The EleC must prepare their tender based upon the material specified, but may offer alternative materials to those specified, by listing them on a supplementary sheet to their tender.

Any alternative material offered shall not form part of the tender offer, but will be considered provided there is a benefit to be gained, either in cost, quality, or delivery.

The design responsibility for the change will be vested with the EleC, who will be required to confirm to the Engineer via the Main Contractor, that they (the EleC) indemnifies the Engineer for any time spent and costs incurred by the Engineer as a direct result of changing from the materials originally specified.

The EleC must ensure that all specified materials are correctly applied and installed strictly in accordance with the manufacturer's advice and requirements. Any conflict between information given by the specification and/or tender drawings and given by the manufacturer must be brought to the attention of the Engineer before tenders are submitted.

Any costs incurred by the EleC through not installing materials in accordance with the manufacturer's requirements will not be reimbursed through the main contract.

20 Protection Of The Installation, Equipment And Materials

The EleC shall ensure adequate, safe and suitable storage for all materials and equipment provided by and installed by them.

All materials shall be adequately supported and stored under cover, to prevent bending, distortion and corrosion.

All materials or equipment stored in an unsuitable method will be rejected by the Engineer and replaced at no cost to the Main Contractor. It is the EleC responsibility to ensure the protection of all works and materials up to Practical Completion of the Project.

The EleC shall ensure that the condition of all materials and equipment is maintained during the course of the contract and that no damage, corrosion, soiling or deterioration of any kind, affects the materials or equipment.

The EleC shall provide all covers, protection and other means necessary to ensure that all materials and equipment is in a “As New” condition, upon completion of the contract.

21 Existing Materials

The EleC shall not, under any circumstances, re-use existing materials unless permitted in writing by the EA or unless specifically stated in the Specification or on the drawings.

Where existing materials are to be re-used the EleC shall take full responsibility for the condition, safekeeping and satisfactory re-use of such materials.

22 Variations

Changes to the scope of works shall only be carried out on receipt of written instructions, in accordance with the general conditions of contract. No order for such alterations, additions, or omissions, will be issued until the EleC has submitted an estimate of cost unless specifically instructed in writing by the EA. Such costs shall be submitted to the Main Contractor, with a copy to the Ea and Engineer.

23 Interim Claims For Payment

Interim claims for payment shall include a statement indicating:-

- Value of work complete for each defined price section of work in the Summary of Tender.
- Priced schedule of unfixed materials on site.
- Value of work complete against each agreed variation.
- Value of unfixed materials on site for each agreed variation.
- Application for payment must be made to the Main Contractor for approval, prior to raising a VAT invoice to the main contractor.

Materials stored off site will not be paid for.

24 Measurement Of Works

The EleC shall give all necessary assistance to enable the Engineer to examine or measure any of the Works.

No work is to be covered or concealed, or insulation applied, to any section of the works, without seeking prior approval of the Engineer.

The EleC shall give notice to the Engineer, via the Main Contractor, of not less than two working days as to when the works which are to be covered or buried shall be ready for examination and the Engineer or their representative shall carry out such examination and/or measuring without undue delay but in any event within two working days

25 Engineers Time

Any time expended by the Engineer as a direct result of the Main Contractor or EleC not complying with the terms and condition of the contract, or the specification, will be contra charged by the Employer to the Main Contractor and EleC (where applicable).

26 Performance Tests

The EleC shall satisfy the Engineer by means of suitable test procedures, during erection and final test on completion that the whole of their work is carried out in accordance with all rules and regulations applicable to the work, and shall provide at their own expense all testing, apparatus, etc., and shall provide all labour required. The accuracy of the tests must be to the satisfaction of the Engineer whose decision will be final.

27 Practical Completion

Practical Completion will not be achieved until works are complete to the satisfaction of the Engineer and all testing and commissioning is satisfactorily completed.

28 Commissioning And Completion

The EleC shall ensure that the whole of the works is complete, tested and commissioned, before the final inspection is carried out by the Engineer.

The EleC shall clear away all rubbish and surplus materials and ensure that the whole installation is in a clean, sound and satisfactory working order.

When the EleC is confident that the works are complete, they shall inform the Main Contractor, whereupon an inspection will be carried out by the Engineer and a list of outstanding and/or remedial works prepared. The EleC shall attend to all items noted immediately in order that the installation is completed to the Engineer's satisfaction before the handover date.

The EleC shall provide attendance to all commissioning carried out by specialist Contractors and shall be responsible for the satisfactory completion of such works.

The EleC shall also provide attendance during the commissioning of any other site works where they have had a contractual involvement.

The Engineer will not certify completion until all works under the contract have been completed, tested and demonstrated to their complete satisfaction.

The EleC shall, through the Main Contractor, advise when all listed items have been attended to, such that a confirmatory re-examination may be carried out by the Engineer.

If such advice is not received, re-examination will be carried out to suit the Contract requirements, before handover. If the re-examination determines that the EleC has not successfully cleared the list of items, all costs incurred by the Engineer in subsequent inspections will be the responsibility of the EleC and be debited from the final account or invoiced direct to the Main Contractor at the Employers Sole Discretion.

29 Final Inspection And Handover

Upon completion of all outstanding works and/or remedial works the EleC shall notify the Main Contractor that all works are ready for inspection. An inspection will then be carried out at an agreed date to suit all parties. The inspection will be carried out by the Engineer or their representative and a responsible representative of the EleC shall be present and all spare equipment and drawings shall be on site.

Should it be found that the works are not finally completed and satisfactory, the Employer will contra charge the EleC for the Engineer's abortive time. The "As Fitted" drawings and maintenance manuals shall be handed to the Engineer at the time the final inspection is carried out.

30 Operating And Maintenance Manuals

Operating and Maintenance Manual shall be provided at or before handover, such that the Employer is fully informed of the correct operational techniques necessary for its safe use. The manuals shall be issued to the Planning Supervisor for incorporation into the main manual issue. Failure to comply with this requirement will delay handover.

Manuals shall comprise the information detailed in the technical sections of the Specifications.

The manuals shall be bound and titled, contain an index for ease of reference and prominently display the name and address of the Contractor and the Engineer together with emergency telephone numbers.

31 The Construction (Design & Management) Regulation 1994 Statutory Instrument 1994 No. 3140 Health And Safety Hereinafter Referred To As CDM Regulations

The EleC shall, before submitting a Tender, be fully aware of the requirements of the above Regulations.

The EleC shall include in their tender for fully complying with all requirements of current UK Health and Safety Legislation, Regulations and Codes of Practice, including the 1994 CDM Regulations and any transitional provision of the regulations and subsequent amendments.

The EleC shall include for all liaison required by the Planning Supervisor and Main Contractor as defined in the CDM Regulations or any other party for the production of all Method Statements, Health and Safety Plans, details, documents, information, etc., as required by the Planning Supervisor, Main Contractor or others, such that the Health & Safety Plans as required under the CDM Regulations, can be produced and the requirements of the regulations can be met.

The EleC shall include for the continual update of documents, etc. as necessary, and for the provision of all record drawings, plans, maintenance procedures, O & M Manuals, details and locations of all materials used during the construction phase, etc., as required by the Health and Safety Executive and any other documents that may be required such that a completed Health and Safety manual can be finally produced and handed to the Employer by the Planning Supervisor, Main Contractor or other party in order that the Employer has final documentation to satisfy the CDM Regulations and to enable the Employer to operate and maintain the "Works" in accordance with HSE legislation.

32 Overtime Working

The tenderer should note that all overtime working, (within the constraints of the planning conditions) must be carried out in order to achieve the completion date and that all costs associated with this must be included within the tender sum. No claim for additional costs arising from any overtime working will be entertained.

33 Asbestos Health And Safety

Working with asbestos

Between the 1950's and 1980's asbestos materials have been used in buildings for sealing, insulating and boarding. Since 1985 all forms of asbestos materials for use within the standard construction industry has been banned due to positive links that the material can lead to a number of fatal diseases.

Typical use of asbestos in buildings

The material is likely to be present on many refurbishment projects and all contractors and site operatives should be alert and aware of the possible locations where asbestos may be located. Due to the materials extremely low heat conductivity and fire resistance, asbestos has been used extensively for insulation and fire compartmentation.

During the last 50 years asbestos has typically been used for the following applications:-

- Thermal insulation to steel framed buildings,
- Boiler plant insulation - pipework, calorifiers, flues, boiler construction,
- Ceiling fire breaks,
- Panelling, ceiling tiling, partitions, soffit boards,
- Duct fire proofing - internally and externally,

- Asbestos water tanks, down pipes, gutters, roofing materials.
- Asbestos ropes and cloth.
- Paints, coatings, wood fibre-board facing.

As the material has been used so liberally, asbestos may be present in many other applications which are not listed above.

Typical hazards from asbestos

Left undisturbed asbestos provides little risk to operatives, but care shall be taken to ensure that there is no risk of an operative being contaminated.
Before any work begins on site any asbestos-containing materials should have been located and identified. The EleC must have asked the Main Contractor whether an asbestos survey has been carried out and be fully satisfied with the response/result before beginning any works.

If any operative is in any doubt of the material, they shall not disturb it and shall seek further professional advice.

Asbestos fibres can be released and pose hazardous if the material is:-

- Drilled,
- Cut,
- Dropped,
- Broken,
- Impacted on etc.

Although not dangerous to touch, the material fibres can be fatal when inhaled.

Asbestos hazard reduction

If there is any risk of any tools, equipment, personnel or plant accidentally damaging a suspected or known asbestos material, the material shall either be adequately protected or removed by a specialist HSE licensed contractor.

No unlicensed contractor shall attempt to remove the material

The appropriate action of how to eliminate the risk of contamination shall be decided by the design and construction team with the help of a professional advisor.

More information

For further information regarding asbestos you can contact:-

- Company Health and Safety Officer,
- Project Health and Safety Consultant,
- Local Health and Safety Executive,
- Local Environmental Health Department,

Publications can be obtained from the HSE.

In the first instance, the EleC shall at any sign of asbestos, stop all works and identify the area in question to the Main Contractor.

Section 2

Standard Electrical Specification

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Section 2 - GENERAL CLAUSES

1.0 INTRODUCTION

1.1 This section is intended to show the standards of workmanship, safety, etc., expected from the installer of Electrical Works. It is not intended to be read in isolation, and careful cross-reference shall be made with the particular specification the contract Drawings and the following parts which give a detailed description of the extent and nature of the works.

1.1.1 In the Standard Specification when the term installer is used, this shall mean the Electrical Contractor appointed under the contract to carry out the Electrical Service Works.

1.2 If the particular specification is at variance with this standard specification, then the particular specification shall take precedence.

1.3 In the event of there being any discrepancy between the details of the Specification and the drawings, or if there are any matters which are not fully understood then these must be notified to the Engineers in writing for clarification before submission of the Tender. No extra cost will be allowed on this point after the order has been placed.

1.4 Where reference is made to quotations in the particular specification, it shall be the installers responsibility to ensure that all items, quantities and costs etc. contained therein meet the requirements of this specification.

2.0 DEFINITIONS

2.1 The Technical Definitions are as given in the 17th Edition of the IET Wiring Regulations for Electrical Installations, and other terms used are as defined in the Various Parts of BS 3939 and BS 4727.

3.0 REGULATIONS

3.1 Carry out the complete installation of Electrical Services described in these documents in accordance with all relevant/current British Statutory Instruments, Regulations, Standard Specifications, Codes of Practice, and in particular, with:-

3.1.1 The Institution of Engineering and Technology Seventeenth Edition 2015 of the Regulations for Electrical Installations, including amendments published up to and including the tender Invitation date;

3.1.2 Regulations under the Electricity Acts;

3.1.3 Requirements issued by the Local Electricity Undertaking;

3.1.4 Health and Safety at Work Act;

3.1.5 British Standards;

3.1.6 Codes of Practice;

3.1.7 The Factories Acts;

3.1.8 The Building Regulations.

3.1.9 Current Issue of the Construction (Design and Management) Regulations.

4.0 POSITION OF ALL POINTS, SWITCHES ETC.

4.1 Although every endeavour has been made to show details of design, check all measurements and work to the larger scale detail plans in the possession of the Clerk of Works or Building Contractor to verify dimensions, positions etc. Do this before work is commenced. In the absence of large scale drawings being available, agree all positions with the Architect.

4.2 The symbols representing electrical points, accessories, etc,. are not drawn to scale, so do not scale down dimensions from the drawings. Make allowances for varying the position of all electrical points, accessories, etc, within a 600mm radius.

5.0 MOUNTING HEIGHTS

5.1 The heights given are for general tendering purposes and apply unless otherwise detailed in the particular specification or on the drawings.

5.2 The heights given apply to the centre of the box, unless otherwise stated, but make due allowance for any building feature, i.e. wall tiling, etc,. making adjustment to coincide with the centre of the tile.

5.2.1	Lighting Switches	1200mm
5.2.2	Appliance Control Switches	1200mm
5.2.3	Push Buttons and Starters	1200mm
5.2.4	Fire Alarm Break Glass Units	1200mm
5.2.5	Socket Outlets (Check Drawings)	450mm
5.2.6	Fuse Connection Units	1200mm
5.2.7	Indicator Lamps and Alarms Bells	1500mm
5.2.8	Distribution Boards (to Underside)	1800mm

5.3 Check all heights with the Engineers before actual installation commences. Heights given on drawings take precedence.

6.0 DESIGN CRITERIA

6.1 The main distribution schematic diagram indicates the design criteria which were applicable at the time of tender. Include maximum assessed current demands, earth loop impedance, prospective fault currents and voltage drop values together with cable lengths associated with each distribution board position.

6.2 Do not make changes to the installation, which invalidates the design values without written agreement from the Engineers.

6.3 Cable lengths indicated on the drawings are for design purposes only; do not use for preparation of the tender price or ordering purposes. Measure all cables, trunking and trays, routes etc. on site prior to ordering.

6.4 The design documentation will form the basis for comparison with measured results obtained during the testing and commissioning phase of the installation. Bear in mind at the outset of the Contract that all values indicated on the tender drawings shall have measured results inserted in the spaces provided. This is stressed so that measurements are taken before installation proceeds to a point beyond which insufficient access and, in the case of partially handed over areas, safe working practice and disruption to the Employer preclude such actions.

7.0 SUPPORTS AND FIXINGS

7.1 Supply and install complete all necessary support steelwork, brackets and suspension threaded rod etc., to support the electrical installation defined in this specification and shown on the drawings.

7.2 Refer to the appropriate clauses of this section of the Specification for methods to be adopted under certain installation conditions.

7.3 Paint all support steelwork erected to suit the class of installation i.e. standard paint finish (Class 2) for non-surface/interior areas and galvanised finish (Class 4) for surface and exterior areas unless otherwise defined in the particular specification.

7.4 Do not fix electrical services to the mechanical services support steelwork where it is subjected to vibration of heat transfer. In these instances, and in general, install independent support rods.

7.5 Ensure each Installer engaged under the contract provide the necessary support steelwork required for that Installers services. Implement co-ordination of the services from the outset of the Contract with all other Installers and if necessary, identify as an item on the contact programme of work.

8.0 EXPANSION JOINTS

8.1 Supply and install complete, all necessary expansion joint units for services such as conduit, tray, trunking etc. where these cross vertical and horizontal building expansion joints.

8.2 Ensure each unit is if a recognised pattern supplied by the appropriate service manufacturer.

8.3 Where cables cross expansion joints clamp loosely within the respective fixing saddles/cleat to allow movement and in extreme cases install formed loops. Refer to the particular specification or the drawings for further details.

9.0 STANDARD OF MATERIALS

9.1 General

9.2.1 Ensure materials and products shall comply with the following:-

.1 This specification.

.2 Local Authority Bye-Laws.

.3 Electricity Supply Authority Requirements.

.4 Fire Prevention Officer's Requirements.

.5 Any other special licensing Authority Requirements

.6 IET Regulations for Electrical Installations 17th Edition.

.7 BASEC (British Approval Service for Electric Cables).

9.1.2 Notify the Engineers of any revisions or additions to the foregoing as they are published during the installation of the works. The Engineers will give appropriate instruction in each case.

9.2 Quality Of Materials

9.2.1 The works are to be executed with the materials indicated in the specification. The tender must include for all makes of materials and components specified but alternative makes of equal quality may subsequently be offered for consideration by the Engineers. Only use alternatives upon receipt of written instructions from the Engineer. Where materials and components are not specifically described, they are to be the best of their kind and, if required, submit samples or drawings of such materials or components to the Engineers for comment.

9.3 Faulty Materials and Workmanship

9.3.1 The Engineers or their representative shall have the right of inspection of all works on site and have the right to reject any materials which are unsatisfactory due to poor workmanship, damage or failure to meet the specified requirement and to instruct the rectification of the same forthwith at no extra charge. Any costs arising in the building works or the works of other trades consequent of the replacement of faulty or damaged materials and any extra cost arising from the delay in the replacement of same shall be at the Installer's expense.

10.0 SITE INSPECTION

10.1 The Contractors attention is drawn to the requirements laid down in other clauses of this Specification in respect of the necessity for a site visit to be made by the Contractor prior to the completion his Tender, in order that he may be fully conversant with the extent and location of the site.

10.2 No extras after the commencement of the Contract will be considered by the Engineers on the basis of the Contractor having insufficient knowledge of the actual site conditions prior to tendering.

11.0 PROGRAMME

The Sub-Contractor shall include for working within a detailed programme of Works prepared by the Main Contractor. The Sub-Contractor shall include for providing the Main Contractor with a fully detailed programme showing all trades and sections of work together with their starting and finishing dates which form part of the Sub-Contract and discussing and amending the programme in conjunction with the Main Contractor in order to comply with the Main Contractor's programme.

12.0 CO-OPERATION WITH OTHER CONTRACTORS' TRADES

The Sub-Contractor shall co-operate with all other trades on the project and give such information to them as may be necessary in connection with his work in sufficient time for them to perform their work in accordance with the approved programme. The Sub-Contractor shall keep himself acquainted with the progress of work being performed by other trades and arrange his work accordingly. He shall be held responsible for any extra costs incurred by him or by other trades for extra work or abortive work which, in the opinion of the Engineer/Architect is due to his failure to consult properly with other trades prior to installing his work.

13.0 CO-ORDINATION

The sub-contractor shall ensure that all parts of the sub-contract installations are fully co-ordinated in respect of providing the necessary labour and materials as and when required by the contract programme. The sub-contractor shall further ensure that all parts of his installation are full co-ordinated with the fabric and structure of the building and all other services installed. It shall be the sub-contractors responsibility to obtain and interpretate the necessary information to co-ordinate the works. No costs will be accepted for any claims for lack of performance in this respect.

The sub-contractor will be required to provide a fully competent person, able to control the contract works and to co-operate, co-ordinate and liaise fully with the Main Contractors site management and the Engineer, attend site meetings and generally ensure the smooth running of the contract works and ensure that the work is installed to best engineering practises and in accordance with the programme.

The sub-contractor shall check all drawings and available information before installation. Any change required, through lack of compliance with this item shall be at the expense of the sub-contractor.

14.0 DEFINITION OF EXAMINATION OF INFORMATION

The sub-contractor shall understand that wherever he submits information to the Engineer for examination, such examination and comment will be given in principle only, and will not, in any way, invalidate the sub-contractors responsibility for ensuring the accuracy and suitability of the information in accordance with requirements specified elsewhere.

The exact position in the works of service relative to grid lines, floors, beams, ceilings, walls and other structural or construction items and any other services, is a matter of co-ordination and thereby is the responsibility of the sub-contractor. The Employer's examination does not absolve the sub-contractor for the necessity of checking these items.

The sub-contractor shall be responsible for any discrepancies, errors or omissions in drawings and other particulars supplied by him, whether they have been examined by the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars given in writing by the Engineer.

15.0 SUB-CONTRACTORS DRAWINGS AND CALCULATIONS

The sub-contractors shall prepare and submit, for comment of the Engineer, installation and builderswork drawings for all systems to be installed under this sub-contract, together with such schedules of data, calculations and other information called for by the Engineer. The drawings are not to be schematic, but are to be fully detailed as to the positions and physical dimensions of all components in the systems.

The installation drawings shall illustrate in detail the arrangement of the various sections of the sub-contact works and identify or describe the various component

The sub-contractor shall integrate and co-ordinate the drawings properly with the detail of the building and with the work of the other trades and other services installations.

The drawings shall locate and identify all necessary test points, access positions or other provisions necessary for commissioning.

The minimum scale for installation drawings shall be as follows:-

-	Floor Plans	1:50
-	Floor Sections	1:20
-	Plants Rooms	1:20
-	Details of services in ducts and shafts	1:20

The style, presentation, notation and symbols employed on drawings are subject to the approval of the Engineer.

The drawings shall be submitted in the form of dyeline prints drawn on A series specified in BS 3429, titled, numbered and dated in approved manner. General arrangement drawings shall detail the space required for installation, maintenance and replacement, service connections required, environmental requirements, weights and foundation and fixing details. Where appropriate, manufacturer's detailed drawings shall be submitted in triplicate for comment. The Engineer shall be submitted in to call for supplementary information at the sub-contractors expense. This may include calculations, schedules, further drawings, samples, etc, if the Engineer considers it necessary to clarify a point of design, installation, operation or maintenance.

The drawings shall show, were appropriate, the spaces allocated for the installation of work by other sub-contractors. The sub-contractor shall provide all information necessary to enable the builderswork associated with the sub-contract works to be carried out.

The sub-contractor shall provide builderswork drawings giving positions, sizes and details of all chases, holes, concrete plinths and bases, fixings, secondary steelwork, etc. that are required for the execution of the sub-contract works.

16.0 INSPECTION BEFORE CONCEALMENT

Whenever work requiring inspection or testing is subsequently to be concealed, due notice shall be given to the Engineer so that inspection may be made or tests may necessitate the sub-contractor uncovering the work and reinstating at his own expense.

17.0 INTERPRETATION OF DOCUMENTS AND DRAWINGS

The Engineer's specification and drawings shall be interpreted in accordance with relevant installation practice.

Where the Engineer's drawings are to a small scale and/or are expressed in symbolic terms or are in the form of a diagram then indication of the exact location and detail of pipes, ducts, cables, or other components shall not be inferred.

Dimensions written on drawings shall, in all cases, be taken in preference to dimensions given by the scale and the wording of the Specification shall be taken in preference to dimensions

written on the drawings but any conflicting information shall be brought to the notice of the Engineer.

The Sub-Contractor shall read jointly the documents and drawings issued with the tender and draw the attention of the Engineer to any discrepancies and to anything which in his opinion may be unsuitable, undesirable or inconsistent with his guarantees and responsibilities.
The Sub-Contractor shall draw the Engineer's attention to any discrepancies in documents, drawings or instructions issued after the time of Tender, immediately upon receipt of same and prior to the commencement of any part of the Sub-Contract Works affected thereby.

18.0 ENGINEER'S CONSENT

The Engineers' consent or comment on Sub-Contractors proposals and drawings shall not relieve the Contractor or the Sub-Contractor of contractual responsibilities and obligations.

The Sub-Contractor shall be responsible for any discrepancies, errors or omissions in drawings and other particulars supplied by him, whether they have been examined by the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars given in writing by either the Architect or the Engineer.

19.0 INSPECTIONS AND TESTS AT MANUFACTURER'S WORKS

Inspections and tests of all specified materials and/or equipment shall be allowed for and arranged at manufacturer's works. Tests shall conform to appropriate British Standards and/or as specified.

The Sub-Contractor shall, whenever called upon so to do, make arrangements for the Engineer to witness tests at reasonable times during manufacture of any materials and/or equipment being supplied as part of this Sub-Contract.

20.0 SPECIFIED QUOTATIONS

Where a quotation from a manufacturer or supplier is referred to in this Specification, it is the responsibility or the Sub-Contractor to confirm with the manufacturer or supplier that the quotation is still valid and that the equipment described therein still complies in full with the technical detail, quoted price and contractual requirements. Any discrepancy must be reported immediately to the Engineer in writing.

21.0 PROTECTION OF THE SUB-CONTRACT WORKS

All equipment, materials and components shall be in perfect condition when handed over. The Sub-Contractor shall be responsible for leaving uncompleted sections of the Sub-Contract Works in a safe condition and shall include for any temporary works necessary to give reasonable protection from unauthorised interference.

22.0 SCHEDULE OF RATES

After tenders have been received the Sub-Contractor shall, if at any time, so requested at his own expense submit within 14 days of the request, three copies of a schedule of material, equipment, etc, fully priced and totalled and drawn up in the form of Bill of Quantities in accordance with the principles of the Standard Method of Measurement. The schedule shall include all items of work and materials required to complete the Works and shall total the amount of the Tender submitted. Items normally treated as preliminaries are to be shown separately in the schedule. The Engineer may call for further documentation to substantiate the rates given. If it is found, prior to or following the placing of the Contract, that items necessary to complete the Works are missing from the schedule of rates, the Sub-Contractor shall adjust the schedule to the Engineers' satisfaction to show such items whilst maintaining the correct total for the Tender. If there are items which are not detailed in the schedule of rates, the Engineer shall have power to vary the rates in the schedule to take account of the omission.

23.0 TENDER DRAWINGS

The tender drawings are those supplied to the Sub-Contractor for the purpose of submitting his tender and are indicative of the general functional requirements and the approximate physical relationship of the engineering services. The drawings are not construction drawings nor are they fully detailed as to components, etc. They are to be read in conjunction with the requirements of this specification and any codes and standards, which are referred to in this specification and any statutory requirements which may apply.The tender drawings issued with these documents have been prepared in association with drawings and details produced by the Architect and the Structural Engineer.

No claim shall be entertained that the Tenderer was unaware, and did not make due allowance for details shown on Architectural and Engineering drawings.

24.0 PRACTICAL COMPLETION OF THE SUB-CONTRACT WORKS

Practical completion of the Sub-Contract Works shall be deemed to have taken place on the day named in the Certificate of Practical Completion of the Works issued by the Architect. Prior to that date the Sub-Contractor shall have :-

- achieved practical completion of the Sub-Contract Works.
- made, in the presence of the Engineer the tests specified or reasonably required by them.
- handed to the Engineers the whole of the Record Documentation in accordance with the Specification.
- instructed the staff of the Employer in the use and correct operation of the Sub-Contract Works.

STANDARD SPECIFICATION

PART 2 - METALLIC CONDUIT AND FITTINGS

Clause	Description
1.0	PROTECTION AGAINST CORROSION
2.0	METALLIC CONDUIT
3.0	METALLIC CONDUIT AND FITTINGS
4.0	METALLIC CONDUIT AND FITTINGS - INSTALLATION
5.0	CONDUIT INSTALLATION - CONCEALED
6.0	CONDUIT INSTALLATION - SURFACE
7.0	METALLIC FLEXIBLE CONDUIT
8.0	PROTECTIVE CONDUCTORS IN METALLIC CONDUIT

PART 2 - METALLIC CONDUIT AND FITTINGS

1.0 PROTECTION AGAINST CORROSION

1.1 Ensure conduit system comply with BS 4568, BS 6053, BS 6099 and where applicable BS 5490, and are of the heavy gauge solid drawn welded and screw pattern. Ensure conduit systems are mechanically and electrically continuous throughout.

1.1.1 For details of 'systems' refer to Clause 8.0 Part 1 of this standard specification.

1.2 Ensure the class of protective finish is as follows:-

1.2.1 Class 2 - Medium protection, stoved enamel or air drying paint both inside and outside apply to the general installation work in locations where Class 4 protection is not required.

1.2.2 Class 4 - Heavy protection, and hot dip zinc coated or screaded both inside and outside.

1.2.3 Areas deemed to be included as Class 4 areas (unless modified in the particular specification) are:- Kitchens; Plantrooms; Tank Rooms; in Ducts buried in ground; external and internal areas subject to dampness.

1.3 Ensure the protective coatings on conduits and fittings are the same class and are never mixed either up or down in Class of protection.

2.0 METALLIC CONDUIT

2.1 Do not use conduit less than 20mm diameter

2.2 Thread conduits to the correct length reamer at both ends. Clean off all lubricants and swarf. Clean existing threads by using appropriate running dies before installation.

2.3 Ensure all conduits and fittings are free from defects and rust on delivery to site, and store in covered racking properly protected from any damage or weather. Do not store conduits on the ground.

2.4 Replace conduits where the protective coating is damaged, or where the protective coating becomes damaged after installation. The Engineer, at his discretion, may allow such conduits, to remain but make good the rust patches by cleaning down to bright metal, priming and re-painting to match the existing, to the satisfaction of the Engineer.

3.0 METALLIC CONDUIT FITTINGS

3.1 Ensure all fittings are malleable iron conforming to BS 4568, Part 2.

3.2 Saddles:

3.2.1 Ensure Class 2 protective areas have spacer bar type saddle with 3mm clearance between the conduit and fixing surface.

3.2.2 Ensure Class 4 protection areas have distance spacing type saddles with 12mm clearance between the conduit and fixing surface. Ensure brass fixing screws are used in Class 4 areas.

3.3 Conduit Boxes:

3.3.1 Ensure Class 2 protection areas have conduit boxes complying with Clauses 3.3.2 - 3.3.5 inclusive.

3.3.2 Ensure circular malleable iron for all draw-in boxes, lighting points, angle boxes, tee boxes, and any junction up to four conduits. In all other cases use adaptable boxes of the appropriate protective finish.

3.3.3 Ensure all boxes, unless with a direct mounting accessory or fitting, have heavy steel covers fixed with brass screws.

3.3.4 Ensure covers are oversized where used as flush inspection points and with break joint rings at luminaire and ceiling switch positions. Ensure conduit boxes, with the exception of loop-in boxes, are spout entry, standard or deep pattern.

3.3.5 Ensure loop-in boxes are of the non-screwed entry type.

3.3.6 Ensure conduit boxes in Class 4 protection areas are as those described as Class 2 above, but with hot dip galvanised finish.

3.3.7 In instances where the installation is mounted outside a building, or in situations of continual dampness, ensure hot dip galvanised finish conduit boxes have external fixing lugs with malleable iron covers and mating machined surfaces and where necessary appropriate neoprene gaskets to maintain the IP rating of the installation.

3.4 Adaptable Boxes:

3.4.1 Ensure fitting to BS 4568 and made of malleable iron or heavy duty steel with welded joints and tapped lugs to receive the cover screws. Ensure boxes have the same protective coating as the conduit installation. Where used in a Class 4 installation, in exterior locations, or in areas of continual dampness, ensure that adaptable boxes have external lugs and a waterproofing seal between the box and the cover. In other Class 4 areas external lugs are not required.

3.4.2 Ensure that where provided as junction boxes with permissible cable joints, the adaptable boxes are of adequate size to receive a fixed base porcelain or heat resisting terminal blocks capable of withstanding the same temperature as the cable insulations.

3.4.3 Allow for cable sweeps and neat connections.

3.4.4 Install the terminal blocks securely fixed to the box, using sealing washers and compound in exterior locations or in areas of continual dampness.

3.4.5 Where necessary, provide adaptable boxes with earthed barriers to segregate services.

3.4.6 Provide overlap lids on flush installations.

3.5 Bushes:

3.5.1 Where loop-in and non-screwed entries are provided use only brass, male type, long threaded bushes and associated coupling. Do not use lock nuts and ring bushes affixed directly to the conduit.

3.6.1 Ensure couplings are to BS 4568 Part 2, with protection against corrosion, as applicable.

3.7 Earthing Terminals:

3.7.1 Provide earthing terminals securely fixed to the box on all equipment boxes, conduit accessories and adaptable boxes to which cables or flexible conduits are fitted, or to boxes upon which accessories or equipment are mounted.

3.8 Serrated Washers:

3.8.1 Use spring metal, female type.

4.0 METALLIC CONDUIT AND FITTINGS - INSTALLATION

4.1 Carry out all conduit work, whether surface or concealed, in accordance with sound and general practice and in a workmanlike manner by skilled tradesmen.

4.2 Ensure conduits are surface or concealed as detailed in the particular specification.

4.3 Size all conduits in accordance with the 17th Edition of the IET Wiring Regulations.

4.4 Take care with the appearance of the installations. Install all accessories, adaptable boxes, draw-in boxes, etc, "square" with regard to the building fabric. Where multiple boxes are in the same general location care shall be taken to ensure a neat and symmetrical appearance.

4.5 Install inspection boxes in accessible positions at high or low levels in walls, not ceilings, and site in unimportant areas, e.g. Stores. If this is not practicable, place them give in due regard to switch and socket positions and any aesthetic requirements after prior approval of the Engineer.

4.6 Cut all conduit thread "square" to the correct length and properly butt. Do not allow exposed threads, except on running couplings. Ream all ends smooth.

4.7 Where conduits are connected to trunking, metallic boxes, panels switchgear, or any item not having a tapped entry (or a tapped entry of 6mm or less), make the connections by long threaded male brass bushes with a coupling and serrated spring washer after removing the paint with a purpose made tool.

4.8 Tighten bushes with a tool specifically designed for that purpose - do not use pliers or toothed wrenches.

4.9 Only allow locknuts with running couplings in Class 2 areas.

4.10 Take special care to prevent dirt and moisture entering conduit/installation. Do not leave ends of conduits open during building operations; effectively plug and soar ends with petroleum jelly. Use only screwed caps or shaped plugs.

4.11 Similarly protect conduit entries to all boxes by shaped plugs.

4.12 Form all easy sweep bends on a proprietary bending machine. Do not use 'site' manufactured bends, elbow or tee components or U-bends the radii of 'pulled' bends shall be as defined in BS 4568.

4.13 Space conduits at least 150mm from other services, i.e. gas, water, steam, etc, and where this minimum spacing cannot be achieved, then cross bond at least once per room.

4.14 Allow for sufficient draw-in boxes to permit ease of wiring/rewiring. Ensure the following also applies:-

No of right angled bends	Maximum distance between draw-in boxes
NIL	10m
1	10m
2	6m

4.14.1 For the purpose of this specification, a double-set constitutes the equivalent of 1 No. right angled bend.

4.14.2 Ensure not more than 2 No. right-angled bends or a 10m length of conduit between draw-in boxes.

4.15 Support each bend, set, adaptable box, conduit box, etc, at 150mm each side equally placed.

4.16 Secure saddles and boxes by screws of a minimum size of 30mm x 8 No. or equal.

4.17 Use approved masonry fixing devices except in the cases of wood and metal. Make holes neatly in masonry with a masonry drill of the correct size for the fixing devise to be used. Drill and tap holes in metalwork and use 6mm diameter (min) metal thread screws for masonry fixings.

4.18 Where the items to be fixed have countersunk holes use countersunk screws; use roundhead screws in all other instances.

4.19 Use 2 No. fixing for accessory boxes up to and including 75mm x 75m. Accessory boxes larger than 75mm x 75mm must have 4 No, fixings.

4.20 Note that generally, unless otherwise defined in the particular specification or on the drawings, avoid the drilling of structural steelwork for fixing methods and use only proprietary fixings such as 'clamps', 'rod clips' etc.

4.21 Provide all lighting points, socket outlets, equipment points, etc, with a suitable fire rated box securely fixed to the building fabric, which is able to support the weight of the fittings etc. the box can be the housing of the accessory or equipment provided it is metal with conduit entry. Provide boxes for draw-in points, inspection points, etc, and fix securely independently from the conduit.

4.22 Use graphite paste for lubrication.

4.23 Immediately after installation make good all conduits and boxes with any damage to finish; removed all rust, brush to bright metal, and prime and paint to match the existing finish (see Clause 2.5 above). Similarly treat all exposed threads (only permissible at running joints) and all bush and coupling joints. In Class 4 areas, effect the foregoing by using two coats of zinc enriched paint.

4.24 In areas where there is danger of condensation, fill boxes with moisture repelling compound.

4.25 Adequately drain/clear and swab all conduit works before wiring is carried out.

4.26 Draw in cable in a careful and workmanlike manner. "Comb" cables as drawing-in proceeds and lay the neutral and protective conductors of each circuit with each phase cable of that circuit.

4.27 Ensure that the entire conduit system is electrically continuous throughout, forming a fully bonded system, the whole system being efficiently, effectively earthed. Carry out earth continuity tests before any conduits are concealed.

5.0 CONDUIT INSTALLATION - CONCEALED

5.1 Where concealed, ensure metallic conduit work is Class 2 and complies with Clause 2.4 together with the following Clauses for concealed installations.

5.2 Bury conduit in floor and/or roof screed at least 25mm depth over its entire length. Plan and install routes so that the crossing of conduits is avoided. Ensure conduits laid parallel are at least 150mm apart. Fix conduits laid in "in-situ" concrete securely to the reinforcement steelwork. Fix conduit boxes to the shuttering.

5.3 Where concealed in plastered walls, ensure that the conduit shall have 12mm cover along its whole length, horizontal runs are not permitted.

5.4 Fix by crampers or saddles, or other approved fixing, at sufficient intervals to prevent displacement and in accordance with the 17th Edition of the IET Wiring Regulations. Ensure that care is exercised during the screeding and plastering stages so that the conduit installation does not sustain damage.

5.5 Where conduits are laid fixed across constructional expansion joints, use expansion couplings with suitable earth bonding conductors proving equipotential bonding.

5.6 Where conduits are specified to be installed above suspended ceilings fix to the building fabric at distances to comply with the 17th Edition of the IET Wiring Regulations, by saddles or suspended on steel strapping or on circular steel suspension sets using saddles or patent suspension clips. Do not use suspensions, which allow the sideways movement of conduit.

5.7 Where conduit is concealed above ceilings of plaster, or rigid construction, bring ceiling boxes flues to the finished ceiling level; you may use extension rings to ensure this clause is complied with the conduit shall form a complete "loop in" system.

5.8 With ceilings and walls of the de-mountable type, fit conduit boxes above the ceiling or flush in walls in an extension ring to close the gap to the finished walls or ceilings.

5.9 Ensure all adaptable boxes, draw-in boxes, conduit boxes, etc, have overlapping covers flush with the finished walls or ceilings.

5.10 Where partitions and walls are of such a construction that it is not possible to make a normal conduit entry to the flush accessory box, terminate the conduit in a box deep into the wall with deep extension boxes so as to finish flush with the finished surface.

5.11 Where surface mounting equipment is mounted on a concealed conduit installation, drill, bush and mount the equipment over a recessed adaptable box so as to conceal the flush installation.

5.12 Connect conduit installations from a ceiling or roof position to a position on a wall by a solid coupling 300mm below ceiling level.

6.0 METALLIC CONDUIT INSTALLATION - SURFACE

6.1 Ensure conduit work where installed on the surface, is Class 2 or Class 4, as Specified in the following Part, and complies with Clauses 2.4, and the following additional Clauses.

6.2 Ensure conduits are installed neatly on the surface and routes are truly horizontal, vertical, or parallel with the features or the building. Lay all double sets parallel.

6.3 Wherever possible, located conduits in unimportant areas and pass through walls using back-entry type boxes.

6.4 Support conduits by spacer bar saddles fixed at regular intervals to comply with the 17th Edition of the IET Wiring Regulations.

6.5 Use fixing screws sized 30mm x No. 8, steel for Class 2 work and sheradised, plated or brass for Class 4 work.

6.6 Where two or more conduits are installed parallel, increase and decrease bending radii to ensure a continuous parallel installation.

6.7 Do not use running couplers with locknuts for Class 4 work; use only manufactured conduit unions.

6.8 Where conduits are specified for installation in the ground use those of the Class 4 pattern and wrap in mastic damp-proof bond tape, and extend for at least 300mm beyond the ground emergence point.

6.9 Arrange conduits so that it is impossible for water from condensation or other sources to lodge at any point. Where this is not practicable, drill drain holes (3mm diameter) at the lowest points in the conduit routes or boxes, or at any other points required by the Engineer.

6.10 In multiple conduit installations, do not cross conduits. Where a surface conduit runs through a wall install a back outlet box.

7.0 METALLIC FLEXIBLE CONDUIT

7.1 Ensure metallic flexible conduit complies with BS 731 and is of helical coiled steel with a waterproof sheath overall. Use such conduit generally for final connections to equipment in the following locations:-

7.1.1 All equipment subject to vibration, including all electric motors.

7.1.2 All equipment which is subject to adjustment or which can be withdrawn for maintenance.

7.1.3 Motorised valves, thermostats, controls, sensors, forming part of a piped or ductwork system, storage tanks; oil burners, etc.

7.2 Ensure metal flexible conduit is not less than 300mm, and generally not longer than 1000mm, unless agreed with the Engineers or defined in the particular specification.

7.3 Terminate flexible conduits in factory made couplings forming a waterproof and damp-proof connection. Complete with adapters as necessary.

7.4 Terminate the rigid conduit with an appropriate box to receive the flexible conduit.

8.0 PROTECTIVE CONDUCTORS IN METALLIC CONDUIT

8.1 Attention, is particularly drawn to the following:-

8.2 Ensure that each circuit has its own protective conduit emanating from the distribution board positions and installed within the same conduit as the live conductor(s) of that circuit.

8.3 Attention is drawn to Chapter 54 and Table 54G of the 17th Edition of the IET Wiring Regulations, with regard to protective conduit sizing and requirements.

8.4 At each earthing terminal, on all equipment, appliances etc, clearly identify the protective conductor by cable markers. Fix cables within each equipment box, appliance box, etc, adjacent to the earthing terminal stating:- "PROTECTIVE CONDUCTOR - DO NOT DISCONNECT".

STANDARD SPECIFICATION

PART 3 - METALLIC CABLE TRUNKING

Clause	Description
1.0	METALLIC CABLE TRUNKING
2.0	PROTECTIVE CONDUCTORS IN TRUNKING

1.0 METALLIC CABLE TRUNKING

1.1 Manufacture all metal cable trunking from sheet steel in accordance with BS 4678: Parts 1 and 2, and where applicable BS 5490.

1.1.1 Supply the trunking in standard lengths, free from all sharp edges and projections with each length including a coupling sleeve.

1.2 Gauges shall be:-

1.2mm - for compartment width up to and including 100mm.

1.6mm - for compartment width over 100mm up to and including 150mm.

1.8mm - above 100 x 100mm.

1.3 To protect against corrosion use stove enamel or "Zintec" inside and outside in Class 2 conduit areas, and hot dip zinc coating in Class 4 conduit areas.

1.4 Install trunking routes neatly on the surface truly vertical, horizontal, or parallel with the features of the building.

1.5 Use specified routes. Only use additional trunking if agreed with the Engineer before installation.

1.6 Size the trunking in accordance with the IET Wiring Regulations, not exceeding a space factor of 45%.

1.7 In trunking of 100mm or larger in depth, install additional spring straps to separate cables to avoid bunching of cables in the bottom of the trunking.

1.8 Ensure trunking routes are mechanically and electrically continuous throughout their length. Fit proprietary continuity links to all trunking joints exterior to the trunking, utilising brass bolts and shake-proof washers. Should the trunking not be provided with continuity links, earthing cable links shall be used to ensure continuity.

1.9 Use multi-compartment trunking where segregation of cables is required, consisting of earthed steel partitions of not less than 1.0mm thickness up to and including 100mm deep, and 1,2mm thickness above 100mm deep. Do not pass conduits through the trunking body to serve a particular compartment. Connect conduits to the respective compartments externally utilising appropriate boxes.

1.9.1 In concealed conduit installations terminate the recessed conduit boxes immediately behind the appropriate compartment, and feed cables through a bushed hole.

1.9.2 In the situations where tees and junctions are to be installed lay multi-compartment fittings at such depth as to allow for suitable passover connections.

1.9.3 Install all underfloor/flush floor trunking systems where required and of the appropriate size(s) complete with segregation compartments, laid underfloor or flush with floor as the case may be, fixed straight and level and in accordance with the selected manufacturer's installation instructions.

1 Install complete appropriate floor service outlet boxes, junction and change of direction boxes, vertical intersection boxes and where required flush floor trunking to suit top of screed or other defined finish level.

2 Install all floor boxes of the fully adjustable pattern fitted with the required segregation compartments, quality and type of outlets and required flush or recessed, fixed or hinged lids.

.3 Where trunking is to be laid in floor screeds ensure that no void occurs below trunking lengths and that the routes/boxes are correctly packed. Take precautions to prevent the ingress of screed into the trunking system both during the screed laying process and afterwards until the installation is complete.

.4 Ensure that all floor trunking level alignment is co-ordinated with the respective building contractors and that the desired level is maintained throughout the screed laying process.

.5 Ensure that the underfloor trunking systems are fully re wirable to all final service outlets. Where wire ways only are required then include appropriate draw-in wires to suit the particular system(s).

6. Connect conduits to the trunking system at floor box positions only, unless otherwise defined.

1.10 Provide vertical routed of trunking of 5m or more with heat barriers in a manner approved by the Engineer, to prevent high temperature rise, but fit with internal propriety fire barriers approved by the Engineer when passing through floors or fire compartment walls.

1.11 Ensure insulated pin racks are provided to support cables in vertical lengths exceeding 3m and pin rack maximum centres are 2m. "Spring" removable cable restraining straps into trunking at 600mm (maximum) intervals where trunking covers are fixed on the bottom or side of trunking.

1.12 Ensure trunking covers are fitted the entire length of the route, drip-proof close fitting and of similar protective coating as the trunking. Ensure cover joints do not coincide with trunking joints, but are staggered, thus producing a more rigid construction. Install covers on the underside of trunking in unavoidable circumstances, and then only with the agreement of the Engineers. Do not use self-tapping screws or fixed bridge pieces to hold the cover in position.

1.13 Fit trunking securely to the building in accordance with the 17th Edition of the IET Wiring Regulations.

1.13.1 With trunking up to 50mm wide use only one screw at each fixing point. On trunking over this width use two screws suitably finished as required for the trunking being used. No. 10 (min) up to 75mm width and No. 12(min) for and above dependent upon the trunking size.

1.14 Use manufacturers standard fittings and, only where these are unsuitable, site or workshop fabricated fittings will be accepted with the Engineer's agreement. Finish these to the same protective coating standard and quality of the manufactured trunking. Ensure bends and tees have gussets.

1.14.1 Form all site-fabricated junctions etc. correctly to site size requirements and suitably protect 'leading' edges to prevent damage to wiring.

1.15 Make connection to distribution boards, equipment, panels etc, using manufactured flanges giving the full trunking capacity, making due allowance for the future installation of cable from spare ways. Fit appropriate gaskets and seals between the flange and board etc. to maintain IP rating.

1.16 Make connection between trunking and apparatus by means of a brass male bush, coupling and internally serrated washer, or alternatively, a standard flanged coupling.

1.16.1 Where trunking is cut to receive flanges etc. protect the cut edges of the trunking with a suitable material to prevent damage to wiring.

1.17 The cover must be removable over the whole length of the trunking. In cases where trunking passes through walls and ceiling, provide a short length of cover over the section passing through to form a sleeve for 25mm on each side.

1.17.1 Where flush trunking is used, install flush type covers and ensure the finished edge of the trunking is flush with the fabric of the building.

1.18 Suspensions or fixing must not intrude into the internal space. Use roundhead screws for joining to suspensions or fixings. Remove any burrs to the head of the screw.

1.19 At constructional expansion joints provide the trunking with a sliding coupling complete with a flexible protective conductor ensuring equipotential bonding.

1.20 Do not use trunking in exterior locations.

1.21 Prior to installing cables in trunking remove all debris and take precautions to prevent further ingress of debris.

2.0 PROTECTIVE CONDUCTORS IN TRUNKING

2.1 Attention is particularly drawn to the following:-

2.2.1 Ensure that each circuit has its own protective conductors emanating from the distribution position and installed within the same trunking as the live conductor(s) of that circuit.

2.1.2 Chapter 54 and Table 54G of the 17th Edition of the IET Wiring Regulations, with regard to protective conductor sizing and requirements.

2.1.3 At each earthing terminal, on all equipment, appliances etc, clearly identify the protective conductor by cable markers. Also fix labels to each equipment box, appliance box etc, adjacent to the earthing terminal stating "PROTECTIVE CONDUCTOR - DO NOT DISCONNECT".

STANDARD SPECIFICATION

PART 4 - CABLE TRAYS

Clause	Description
1.0	GENERAL
2.0	INSTALLATION OF CABLE TRAY
3.0	INSTALLATION OF CABLES

PART 4 - CABLE TRAYS

1.0 GENERAL

1.1 Ensure cable trays are perforated sheet steel to BS 1449, hot dip galvanised to BS 729: Part 1 BS 2989 and formed with returned flange. Ensure thickness of tray is not less than:-

1.1.1 0.9mm For up to 100mm width

1.2.1 1.6mm From 101mm up to 300mm width

1.1.3 2.0mm From 301mm to 600mm width

1.1.4 2.5mm For all exterior applications.

1.2 Allow 30% spare capacity for future cables in sizing of all trays.

1.3 Take care to avoid any electrolytic action between dissimilar metals. Never allow any copper cable or fittings to be in contact with the galvanising. Generally ensure cables are PVC and/or LSF served. Where cables have no serving then lay these on a layer of PVC material securely fixed to the tray. For further details of cable installation refer to the relevant Parts of this standard specification.

1.4 Use standard factory made fittings wherever practicable. If the local situations encountered make it impracticable to use these, fabricated fittings will be accepted provided they are of the same quality and protective finish.

1.5 Ensure sets and bends are sized to allow for the minimum permissible radius of the largest cable on the tray. Ensure cables shall retain their relative positions on all bends and sweeps.

1.6 Maintain earth continuity at all joints with suitable earthing links. Ensure links have all burrs removed and are made by fishplates and screws.

1.7 Provide bushed linings through all cut holes in the body tray.

2.0 INSTALLATION OF CABLE TRAY

2.1 Allow space between the tray and structure to give ease for securing the cable fixings and general maintenance, 75mm minimum.

2.2. Carry cable trays on mild steel supports with suitable protective coating, fixed to the structure at not more than 1 meter intervals, depending on the cable tray thickness and manufacturers recommendations. Use fixings of expanding masonry bolts or equal. Alternatively, use proprietary steel channel permitting easy adjustment and modification. Channel to be end capped and complete with face capping. This is applicable to all channel used. Propriety clamp fixings on to the flanges of structural beams are also permitted. Subject to approval in writing from the Structural Engineer.

2.3 Prime and paint all metalwork, fixing bolts etc, with two coats of zinc enriched paint.

2.4 Liaise with other Installers/Trades before fixing the tray routes to avoid any obstruction of services and ensure the installation can be adequately installed and maintained.

2.5 Achieve joints in sections of cable trays and fixing of tray to support brackets by means of sheradised mushroom headed bolts and nuts with the threaded portion away from the cables.

2.6 Use ladder rack only when specified in the particular specification and conform to the British Standards previously outlined under this heading and used in manufactured bends, tees, etc unless specified in the particular specification.

2.7 Where cable trays are installed across expansion joints fit a propriety slip connector fixed at one end only.

3.0 INSTALLATION OF CABLES

3.1 Fix cables to tray at minimum spacing in accordance with manufacturers recommendations and the 17th Edition of the IET Wiring Regulations unless otherwise stated in the particular specification using plastic coated clips for cables up to 10 sq mm and proprietary cleats of a pattern recommended by the cable manufacturers for all other sizes.

3.2 Ensure all fixing bolts/studs are sheradised and where necessary of sufficient length to allow stacking of cables. For further details of required fixing methods refer to the relevant parts of the standard specification, the appropriate clauses of the particular specification and the drawings.

STANDARD SPECIFICATION

PART 5 NON-METALLIC CONDUIT AND FITTINGS

Clause	Descriptions
1.0	NON-METALLIC CONDUIT
2.0	NON-METALLIC CONDUIT FITTINGS
3.0	NON-METALLIC CONDUIT FITTINGS INSTALLATION
4.0	NON-METALLIC CONDUITS - CONCEALED INSTALLATION
5.0	NON-METALLIC CONDUITS - SURFACE INSTALLATION
6.0	NON-METALLIC FLEXIBLE CONDUIT
7.0	PROTECTIVE CONDUCTORS IN NON-METALLIC CONDUIT

PART 5 - NON-METALLIC CONDUIT AND FITTINGS

1.0 NON-METALLIC CONDUIT

1.1 Ensure conduits comply with BS 4607, BS 6099 and where applicable BS 54900 and be heavy gauge, high impact, self-fire extinguishing PVC, free from imperfections, smooth inside and outside; of minimum diameter 20mm.

1.2 Ensure conduits are of the same colour throughout the entire installation.

2.0 NON-METALLIC CONDUIT FITTINGS

2.1 Ensure all fittings are of the same specification and colour, and comply with BS 4607 and BS 6099, and as follows:-

2.2 Ensure standard boxes are circular pattern with push fit spouts to BS 4607, with a PVC lid held in place with brass or nylon screws.

2.3 Ensure where supporting cord pull switches, brass inserts are provided.

2.4 Unless otherwise specified in the following Sections, provide circular boxes for all outlet points for luminaires and ceiling switches. Ensure boxes have fitted brass earth terminals and be heat resistant and reinforced with tapped metal inserts for fitting and fixing screws.

2.5 Ensure adaptable boxes are to the same specification as the conduit, square or rectangular in shape, with PVC lids fixed by brass or nylon screws. Do not use adaptable boxes smaller than 75mm x 50mm or larger than 300mm x 300mm. Where cable joints are permitted or specified, Ensure such boxes are of adequate size to contain the terminal block and space for making neat connections.

2.6 Fix the terminal block to the adaptable box using brass or nylon screws and have brass conductors shrouded in heat insulating and electrically insulating material.

2.7 Fit saddles for surface mounted non-metallic conduit of the space bar type with 3mm clearance and the saddles fixed with brass screws.

2.8 Fit saddles for concealed PVC conduits of the single hole, half clip, type.

3.0 NON-METALLIC CONDUIT FITTINGS - INSTALLATION

3.1 Ensure conduits are surface or concealed as detailed in the following Part.

3.2 Ensure all non-metallic conduit work is carried out by tradesmen skilled in this work and is of general and sound practice.

3.3. Ensure all non-metallic conduits are sized to comply with Regulation 529-7 and Appendix 12 of the 17th Edition of the IET Wiring Regulations. Note that the grouping correction factor used in designing the size of cables within conduits is 0.65 (equivalent to 4 circuits).

3.4 Take careful note with regard to capacity of the type of cable to be installed within the non-metallic conduit.

3.5 Securely cement terminations at couplers, adaptor boxes etc. Use proprietary cements for the jointing; "fixed" type for rigid connection and "flexible" type for expansion joints. Insert conduits to the full depth of the spout and cut "square".

3.6 Where conduits terminate at tapped conduit entry boxes, use male plain to threaded adaptors.

3.8 Install separate protective conductors with green and yellow coloured insulation for all circuits and services. Ensure the rating of protective conductors is in accordance with the 17th Edition of the IET Wiring Regulations.

3.9 Fix an earthing terminal in every switch and outlet position and in any box required for the connection of protective conductors.

3.10 Make all bends, with the exception of solid normal bends, on site by using the appropriate bending springs. Make the radius of the bends not less than 2.5 times the diameter of the conduit. Make bends only at ambient temperatures of + 10 C and above. Do not use manufacturers elbows and tees.

3.11 Take special care to prevent dirt and moisture entering conduit/installations. Do not leave ends of conduits open during building operations; effectively plug and coat ends with petroleum jelly. Use screwed caps or shaped plugs only.

3.12 Space expansion joints at a maximum of 6m with a joint made using flexible type cement at the spout and end of a coupler.

3.13 Secure saddles and boxes by screws of a minimum size of 30mm x 8 No., and use-approved masonry fixing devices except in the cases of wood and metal.

3.14 Make holes in masonry neatly with a masonry drill of the correct size for the fixing device used.

3.15 When fixed to metalwork, drill and tap holes and use 6mm diameter min metal threaded screws. Where the item to be fixed has a countersunk hole, use countersunk screws, otherwise roundhead screws.

3.1.15 Note that generally, unless otherwise defined in the particular specification or on the drawings, the drilling of structural steelwork for fixing methods will not be permitted. Use proprietary fixings such as 'clamps' 'rod clips' etc.

3.16 Ensure accessory boxes larger than 75mm x 75mm have 2 No. fixings.

3.16.1 Ensure accessory boxes larger than 75mm x 75mm have 4 No. fixings.

3.16.2 For conduit boxes supporting luminaires and of ceiling switches, use 2 No fixings with large washers.

3.17 Take care in the appearance of the installation. Ensure all accessories, adaptable boxes, draw-in boxes etc, are truly square. Site inspection boxes at high or low level in walls, not ceilings, and in unimportant areas e.g. Stores. If this is not practical, place with regard to switch and socket outlet positions or any aesthetic requirement.

3.18 Do not use non-metallic conduits in situations where ambient temperatures are likely to be lower than -5 C or higher than 60 C. If temperatures are likely to be lower than -5 C but not lower than -25 C then use type 'B' PVC conduit, as described in BS 4607 and BS 6099.

3.18.1 If not clear directive exists than seek the advice of the Engineer.

3.19 Ensure conduits are spaced as far as practicable from gas, water, steam and other services, paying due regard to the temperature limitations of non-metallic conduits.

3.20 Allow for sufficient draw-in boxes to permit ease of wiring/rewiring and minimise the use of draw wires. The following shall also apply:-

No. of Right - Angled Bends/between Draw-in Boxes.	Maximum Distance
NIL	10m
1	10m
2	6m

3.20.1 For the purpose of this specification, a double set constitutes the equivalent of 1 No, right-angled bend.

3.20.2 Do not use more than two right-angled bends, or a 10m length of conduit between draw-in boxes.

3.21 Support each bend set, adaptable box, and conduit box, at 150mm (maximum) on each side, equally spaced.

3.22 Provide boxes at all lighting points, socket outlets, other accessory points, equipment points etc.

3.22.1 Ensure boxes are firmly fixed to the fabric of the building and are capable of supporting the fitting and equipment mounted therein.

3.23 In areas where there is danger of condensation, fill boxes with a moisture repelling compound.

3.24 Ensure all conduit work is drained, cleared, and swabbed before wiring is carried out.

PART 6 - NON-METALLIC CABLE TRUNKING

Clause	Description
1.0	NON-METALLIC CABLE TRUNKING
2.0	PROTECTIVE CONDUCTORS IN TRUNKING

PART 6 - NON-METALLIC CABLE TRUNKING

1.0 NON-METALLIC CABLE TRUNKING

1.1 Ensure that non-metallic cable trunking complies BS 4678: Part 4 and where applicable BS 5490 and is if heavy gauge high impact quality, self-extinguishing extruded PVC compound. Ensure the trunking is smooth inside and outside and fitted with drip-proof lids.

1.2 Size the trunking in accordance with the 17th Edition of the IET Wiring Regulations without exceeding a space factor of 45%.

1.3 In trunking of 100mm or larger in depth, ensure additional spring straps are installed to separate cables to avoid them bunching in the bottom of the trunking.

1.4 Ensure trunking is installed neatly on the surface and is truly horizontal, vertical or parallel with the building features.

1.5 Use specified trunking routes but agree any additional routes required with the Engineer prior to installation.

1.6 Use multi-compartment trunking where segregation of cables is required.

1.6.1 Do not pass conduits through the trunking body to serve a particular compartment; connect conduits to the respective compartment externally using appropriate boxes.

1.6.2 In concealed conduit installations, terminate the sunken boxes immediately behind the compartment served with cables fed back-entry into the trunking.

1.6.3 In situations where tees and junctions are to be installed, place the multi-compartment fittings at such depth to allow for suitable passover connections.

1.7 Do not use non-metallic trunking vertical routes of 5m or more where heat barriers are required in a manner to prevent high temperature rise; use appropriate metallic trunking.

1.8 Do not insert non-metallic trunking in fire compartment walls, or pass through floors. Use metal trunking of the correct classification in these instances with a short length of cover to form a sleeve. Ensure the cover of non-metallic trunking is removable throughout.

1.9 For all changes or direction, terminations, tees, use the manufacturers fittings and suitable gusset bends and tees for the largest cables. Do not use site-fabricated fittings unless the situations encountered make the use of manufactured fittings impracticable. In such case seek the agreement of the Engineer and submit sample site fabricated trunking for consideration.

1.10 Take connections to distribution boards by flanges giving the full trunking capacity. Cement the flange to the trunking. Install an appropriate gasket between flange and board to maintain IP rating of Board etc.

1.11 Ensure insulated pin racks are provided to support cables in vertical runs exceeding 3m. Ensure pin rack maximum centres are 2m. Spring retaining straps into the trunking at 600mm (maximum) intervals where trunking covers are fixed to the bottom or side of trunking.

1.12 Securely fix trunking to the building in accordance with the 17th Edition of the IET Wiring Regulations. Use two screws at each point on trunking of 50mm width and larger.

1.13 Only use trunking with covers in the underside in unavoidable circumstances and then only with the agreement of the Engineer. Do not use trunking in exposed locations.

1.14 To all fixings and connections give due allowance for expansion as recommended by the manufacturer.

1.15 At structural expansion joints provide the trunking with a sliding coupling or other approved method of flexible coupling.

1.16 Do not allow suspensions or fixings to intrude into the internal space. Use roundhead screws for joining of suspensions or fixings. Remove any burrs to the head of the screw.

1.17 Prior to installing cables in trunking remove all debris and take precautions to prevent further ingress of debris.

2.0 Protective conductors in trunking

2.1 Ensure that each circuit has its own protective conductor emanating from the distribution position and installed within the same trunking as the live conductors of that circuit.

2.2 Attention is drawn to Chapter 54 and Table 54G of the 17th Edition of the IET Wiring Regulations with regard to protective conductor sizing and requirements.

2.3 At each earthing terminal, on all equipment, appliances etc, clearly identify the protective conductor by cable markers. Also fix labels to each equipment box, appliance box etc, adjacent to the earthing terminal, stating:- "PROTECTIVE CONDUCTOR - DO NOT DISCONNECT".

PART 7 - CABLES IN CONDUIT AND TRUNKING

Clauses	Descriptions
1.0	CABLES
2.0	INSTALLATION
3.0	CIRCUIT PROTECTIVE CONDUCTORS
4.0	CABLE SIZING AND CIRCUITING

PART 7 - CABLES IN CONDUIT AND TRUNKING

1.0 CABLES

1.1 Generally, install cables of single core, LSF insulated, copper conductors 450/750 Volt grade in accordance with the BS 6004. Use colours as given in the 17th Edition of the IET Wiring Regulations.

1.1.1 Use coloured sleeves only if permitted and at the discretion of the Engineer. Use cable colours as outlined in the IET Regulations.

1.2 Where heat resistant cables are specified use silicon rubber and comply with BS 6007 and 6500, or other heat resistant cable or similar temperature group conforming to the relevant British Standard.

1.3 Do not use cables smaller than 1.5 sq mm and use all cables of the multi-strand type.

1.4 The cable sizing has been designed with the following:-

- A Grouping Correction factor of 0.65 (not more than 4 No. circuits).
- The use of additional straps.

2.0 INSTALLATION

2.1 Carry out all wiring of multi-point circuits in a "loop-in" system, and do not use joints or connections, other than those required for the connection of switches, fuses, socket outlets, motors etc.

2.2 Ensure LSF cables are not in direct contact with any form of polystyrene used in the building.

2.3 Do not install LSF cables when the temperature is below 0C, and if the cables have been exposed to such temperatures, allow a warming up time before the cables are used.

2.4 Do not allow LSF cables to enter any luminaire or heat producing equipment.

2.4.1 In instances of close ceiling-mounted tungsten luminaires, install heat resistant cables (see 1.2 above) from the luminaire to the respective lighting switch.

2.4.2 In the case of recessed tungsten and fluorescent luminaires and heat producing/emitting, equipment having final connections effected using flexible cables.

2.5 Do not use soldered connections or lugs. Terminate all conductors requiring bolted connections with compression lugs using an automatic compression crimp tool which will only release after the correct crimp depth has been obtained. Use spring washers on all bolted connections.

2.6 Double all cables back on themselves when terminations are made. When cable insulation is tripped for connections, take care to ensure that the stripping tool does not damage the conductor.

2.7 Do not use PVC cables for final connections to any appliances containing a heating element for any appliance emitting heat (see Clause 1.2 and 2.4 above). Where flexible conduit is used as a final connection wiring medium, use heat resistant cables and these shall commence at the solid conduit end of the flexible conduit provided it is not in a heated area. If this is not possible, install heat resistant cables back to the first switch or distribution board not in a hot area.

2.8 Do not allow PVC cables to exceed the capacity of the conduit and/or trunking. Comply strictly with the 17th Edition of the IET Wiring Regulations regarding capacity of conduits and trunking for 450/750 volt cable, but do not exceed a space factor of 45% for trunking.

2.9 In the event of any insulation being damaged, e.g. whilst cable are being drawn in, remove and replaced the whole of the cable length. Ensure all cables are installed in accordance with Clause 522-08 of the 17th Edition of the IET Wiring Regulations.

2.10 Where cables of several circuits occupy the same trunking, bind the cables of each circuits together by labelling ties or other approved means, at a maximum spacing of 2m, to provide easy means of identification. Ensure the ties permanently and clearly show the circuit reference number.

3.0 CIRCUIT PROTECTIVE CONDUCTORS

3.1 By reference to Parts 2, 3, 5 and 6 of this Part, the Installer should note that conduits and trunking, whether metallic or not, shall not be exclusively used as a circuit protective medium. Throughout the installation use Circuit Protective Conductors and ensure theses cables are of live conductors of that part of the circuit. Circuit Protective Conductors insulation shall of green and yellow colour.

3.2 Ensure the cross-sectional area of the Protective Conductors is in strict accordance with Table 54G of the 17th Edition of the IET Wiring Regulations.

4.0 CABLE SIZING AND CIRCUITING

4.1 Cable sizes shall be as detailed in the particular specification or as shown on the drawings and wiring diagrams. Where they are not shown sized in accordance with the following:-

4.1.1 Size all cables in accordance with the ratings for LSF cables as given in the relevant tables of the 17th Edition of the IET Wiring Regulations.

4.1.2 Do not use cables less than 1.5 sq mm unless specified in the particular specification.

4.1.3 Fit all circuit conductors with appropriate identification sleeves of the type outlined in BS 3858.

4.2 Feed socket outlets, connection units etc, from ring main or radial circuits and size in accordance with the 17th Edition of the IET Wiring Regulations.

4.2.1 Generally cables for ring main must be 2.5 sq mm (minimum) and 4.0 sq mm (minimum) for radial circuits.

PART 8 - LUMINAIRES, ACCESSORIES, FLEXIBLE CABLES

Clause	Description
1.0	LUMINAIRE
2.0	LIGHTING SWITCHES
3.0	SOCKET OUTLETS
4.0	FUSED CONNECTION UNITS
5.0	LAMPHOLDERS
6.0	CEILING ROSES
7.0	LAMPS
8.0	FLEXIBLE CABLES
9.0	SHAVER SOCKETS
10.0	COOKER CONTROL UNITS
11.0	FUSED CLOCK CONNECTORS
12.0	CONTROL SWITCHES

PART 8 - LUMINAIRES , ACCESSORIES, FLEXIBLE CABLES

1.0 LUMINAIRES

1.1 Supply, erect and connect all luminaires complete with all glass ware, diffusers, mirror/cross bar reflectors lamps, appropriate control gear and where necessary gasket seals, in the positions shown on the drawings and/or described in the following Part. Ensure that luminaires/lighting installations comply with the requirements of BS 161, 354, 559, 764, 1050, 1853, 2818, 3677, 3767, 3772, 4017, 4196, 4533, 4782, 5042, 5101, 5225, 5266, 5371, 5394, 5489, 5490, 5649, 5971, 5972, 6179, 6193, 6274, 6345, 6972, 2001 and CP 1007 as far as they apply.

1.1.1 Attention is drawn to Part is of this Part which gives details of emergency lighting installations.

1.2 Fix every surface mounted luminaire to a conduit box (or boxes), which shall have fixed base terminals, and as specified for the wiring system employed, unless the particular specification allows otherwise. Fix by a back plate, or via a ceiling rose in cases where the luminaires are of a flexible pendent type.

1.3 Fix all luminaires and pendants with brass roundhead screws.

1.4 Include all pendent type luminaires with suspension lengths of 600mm unless more specific details are defined in the particular specification or indicated on the drawings.

1.5 Connect all metalwork on luminaires to the protective conductor with proper and approved earthing arrangements for metalwork (such as sweated-on copper braiding) between downrods and ceiling plates etc.

1.6 Where recessed luminaires are to be supported by the suspended ceiling, ensure the ceiling erector is aware of the quantities and weights. Alternatively suspend luminaires from the structure or ceiling beams over. Use steel stripping or circular steel suspension or proprietary fixing methods. Two fixings at least are required for luminaires up to 300mm wide and four fixings for sizes over 300mm wide.

1.6.1 For each recessed luminaire installed in a suspended ceiling supply and fit an appropriate incombustible 3-pin socket outlet conforming to BS 5733 complete with a plug top. Secure each by a locking ring or screw thread ring and install in a convenient accessible position to facilitate the removal of the luminaire.

1.6.2 Where surface luminaires are to be fixed to conduit boxes, securely fix the boxes to the structure or ceiling beams over, as specified above.

1.6.3 Supply and fix all fixing and suspension materials.

1.7 Ensure the luminaire backplate fully covers the conduit box in concealed installations. Where backplates can be supplied by the manufacturers to comply with this requirement then use these. As a final alternative, use white break joint rings.

1.8 Do not use fluorescent luminaires for through-wiring unless specifically permitted, in which case use heat resistant 150 C cables.

1.9 Use fluorescent luminaires with control gear as specified in the following Part. Use individually fused lamps. Ensure the noise level emitted by the control gear of fluorescent luminaires is in accordance with the following :- 36W/40W, 24Db; 58W/65W - 28dB; 70W/75W - 30dB and 100W/125W - 35dB. All at 250Hz.

1.10 Ensure fluorescent luminaires are individually power factor corrected - use 0.85 (minimum) shunt connected p.f. capacitors.

1.11 Thoroughly clean luminaires before installation, leaving the installation in a new, clean condition at handover. Do not use the permanent lighting installation for temporary lighting purposes during the contract period unless the Engineer gives prior written approval. In such cases provide new lamps at the handover for the Employer's use.

2.0 LIGHTING SWITCHES

2.1 Ensure local lighting switches comply with the manufacture, rating and type as specified in the following Part.

2.2 Ensure lighting switches comply to BS 3676 and, unless otherwise specified, have white insulated faceplates.

2.3 Ensure switches are capable of switching the full rated inductive or resistive load, and where connected to fluorescent loads in excess of 600 watts, use 15 amp rating.

2.4 Ensure ceiling type switches are of B.S. 3676 insulated pattern finished white with single cord operation and mounted on matching insulated pattress, as required.

2.5 Install all switches with boxes of 37mm minimum depth with adjustable lugs to ensure switchplates are true and square. Fit boxes flush with wall finish and make any adjustment to depth with extension rings.

2.6 Ensure all switches have suitable boxes as specified for the wiring system used and complete with CPC terminal.

2.7 Where several switches of the same phase are required in the same position, use a multi-ganged switch box to accommodate all switches on a common faceplate.

2.8 Where switches are specified for Class 4 installation in situations exposed to weather, or continual dampness, ensure they are of the weatherproof pattern B.S. 5490 (IP65) with approved gaskets.

2.9 Where different phases are present at one switch location, segregate each phase in a separate compartment and cover each compartment by its own internal warning plate suitably engraved. "WARNING 415 VOLT PRESENCE"

2.10 Mount switches adjacent the closing style of doors where possible.

3.0 SOCKET OUTLETS

3.1 Ensure socket outlets are to B.S. 1363 switched and shuttered and mounted in single or multigang assemblies, and are of the type and rating as specified in the following Part.

3.2 Unless otherwise specified in the particular specification provide, matching plug tops for 50% of the number of outlets installed and supplied with fuses.

3.2.1 Fit plug tops with fuses complying with B.S. 1362 of the correct rating for the appliance to which they are connected.

3.3 Ensure socket outlets are complete with boxes not less than 35mm deep and having a suitably mounted brass protective conductor terminal.

3.4 Ensure cover plates are of white insulted to match the switches, overlapping for flush installations and of the same size as to the side of the boxes for surface installations.

3.5 Ensure the earth pin of each socket is connected to the box earth terminal with a green/yellow insulated protective conductor. Do not use cover screws for earth continuity.

3.6 Use indicating pattern outlets for appliances with a heating element and in areas indicated in the following Part.

3.7 In Class 4 Protection Areas, where installed in exterior locations, or in areas of continual dampness, ensure outlets weatherproof pattern are of B.S. 5490 (IP65) with watertight caps and approved gaskets. Supply suitable plug tops for each outlet.

4.0 FUSED CONNECTION UNITS

4.1 Ensure these are to B.S. 5733 double-pole switched to unswitched insulated patterns with plates to match the socket outlets.

4.2 Where used as a flexible outlet for an appliance, ensure they are of the flexible outlet pattern with cable anchoring clamp.

4.3 Ensure the fuse types and spares required are as defined for socket outlets.

5.0 LAMPHOLDERS

5.1 Where lamp holders are required ensure these are heat resisting and comply with B.S. 5042, 5101, 5371 where appropriate and, in the case of tungsten luminaires, are also suitable for the following lamp sizes/cap types:-

5.1.1	Up to and including:-	50 watts	- Bayonet Cap.
5.1.2		200 watts	- Edison Screw Cap.
5.1.3		300 watts and over	- Giant Edison Screw Cap.

5.2 Provide ceramic interiors for screw type lamps and when used in Class 4 areas.

5.2.1 Provide brass with ceramic interiors when integral with luminaires.

5.2.2 Provide white plastic with compression cord grip with flexible pendants, skirted or shrouded.

5.3 Ensure batten lamp holders are white heat resistant and skirted.

5.4 Ensure metal lamp holders are effectively earthed using an earth terminal fixed to the lamp holder by the manufacturer.

6.0 CEILING ROSES

6.1 Provide these for all lighting points with a luminaire suspended by a flexible cable without an integral mounting.

6.2 Ensure ceiling roses conform to B.S. 67 of the white insulated pattern incorporating 2, 3, or 4 terminals, as necessary. Incorporate cord grips.

6.3 Where installed in concealed installations as a backing plate, use a white break joint ring.

7.0 LAMPS

7.1 Unless otherwise stated supply and fix complete, ensuring they are of the appropriate type, correct voltage, the specified wattage and of the correct length and colour rendering all as detailed the particular specification, and the schedules/drawings.

7.2 Ensure all lamps are new at handover, allowing reasonable time for testing etc. Do not use them for temporary lighting for building purposes. "Break-in" fluorescent lamps used on dimming circuits for at least forty hours.

7.3 Ensure lamps shall comply with B.S. 161, 1853, 3677, 3767, 5971, 6179, 6193, 6274 as appropriate.

8.0 FLEXIBLE CABLES

8.1 Use flexible cables for pendant luminaires and for final connections to equipment (fixed, or portable). Ensure these are 300/500 volt grade to B.S. 6500: Table II PVC insulated white circular with HC tinned copper conductors of minimum size 1.0 sq mm. Ensure the maximum mass of any suspended luminaire is 3 Kg unless additional support is provided.

8.2 Use heat resistant flexible cables for all other luminaires, or making final connections to equipment (fixed or portable) with a heating element or equipment fixed to pipework or appliance forming part of a heat distribution system, ensure the flexible cables are 300/500 volt grade complying with the appropriate requirements of B.S. 6500, Insulated Flexible Cords, B.S. 6141, Insulated Cables and Flexible Cords for Use in High Temperature Zones and B.S. 6899, Rubber Insulation and Sheath of Electric Cables.

9.0 SHAVER SOCKETS

9.1 Install shaver sockets in accordance with the 17th Edition of the IET Wiring Regulations fed from a local lighting circuit, and ensure they are manufactured in accordance with B.S. 3052.

10.0 COOKER CONTROL UNITS

10.1 Ensure cooker control units are manufactured to B.S. 4177, and are complete with a 45 amp D.P. switch and a 13 amp switched socket outlet, both with neon indicating lamps.

10.2 Mount the cooker control unit alongside the cooker, not directly behind or above.

10.3 Effect final connections via a fixed cable outlet unit as B.S. 5733 and mount directly behind the cooker. For instance where split-level hobs an ovens are to be provided, see the particular specification for exact final connection details.

11.0 FUSED CLOCK CONNECTORS

11.1 Install fused clock connectors for all mains voltage clock points. Ensure connectors and are of the fused plug and socket type, complete appropriately with suitably sized flexible cable for final connections.

11.2 Connect clock connections to the 'local' lighting circuit feed unless otherwise stated on the drawings.

12.0 CONTROL SWITCHES

12.1 Ensure double pole and triple pole and neutral control switches are in accordance with B.S. 3676 and B.S. 5419 (Category AC22) respectively and are suited as other accessories defined in the particular specification.

12.2 Ensure each switch is of the surface or flush pattern as appropriate and install with suitable metal box and flylead.

12.3 Generally ensure switch plates are complete with pilot lamp and where defined in the particular specification engraved with red lettering identifying the equipment being controlled.

12.4 If cable outlet plates are required for final connections to equipment, suit these to other accessories and complete with terminals, cable clamp metal boxes (surface or flush as appropriate) and ensure manufacture is in accordance with B.S. 5733.

PART 9 - MINERAL INSULATED COPPER COVERED AND PVC SHEATH (MICCV) CABLES

Clause	Description
1.0	CABLES
2.0	TERMINATIONS
3.0	BOXES
4.0	INSTALLATION OF MICCV CABLES
5.0	INSTALLATION OF MICCV CABLES - UNDERGROUND
6.0	MICCV CABLES SIZING AND CIRCUITING

PART 9 - MINERAL INSULATED COPPER COVERED AND PVC SHEATH (MICCV) CABLES

1.0 CABLES

1.1 Ensure mineral insulated cables have copper conductors, mineral insulation (inorganic type), copper sheathed, oversheath, and comply with B.S. 6207 B.S. 6387 and the following clauses:-

1.2 600 Volt Grade for:

1.2.1 Socket outlet circuits

1.2.2 Lighting point circuits

1.2.3 Fire Alarm Systems

1.2.4 Call Systems

1.2.5 Extra Low Voltage Systems

1.2.6 Unless otherwise specified in the following Section.

1.3 1000 Volt Grade for:

1.3.1 Motor Wiring

1.3.2 400/415 volt 3 or 4 wire circuits

1.4 Unless otherwise specified in the particular specification do not use cables less than 1.5 sq mm in either voltage grade. Ensure cables have LSF sleeving of Orange finish where used in temperatures up to 70°C. for temperature above 70° C refer to the following section. Ensure cables for fire alarm systems have LSF sleeving of Red finish unless otherwise stated in the standard specification.

1.5 Use the colour coding of conductor sleeving as detailed in table 51A of the 17th Edition IET Regulations.

1.6 Fit shrouds to terminations on all surface mounted LSF served cables.

2.0 TERMINATIONS

2.1 Ensure the equipment for terminating MICCV cables complies fully with B.S. 6081 and is of the same manufacture as that of the cable.

2.2 Ensure seals comply with the following:-

2.2.1 Installations up to 105 C - Cold screw-on pot seal with plastic compound, or alternatively shrink-on type using heat application.

2.2.2 Installations between 105 C and 185 C - Cold screw-on pot seal with suitable plastic compound and bonded glass-fibre caps, or alternatively, shrink-on type seal using heat application.

2.3 Ensure all terminations (with the exception of concealed installations) have brass compression glands conforming to B.S. 6081. However, in areas where installations are concealed within the fabric of

walls etc., then do not use glands but fit proprietary clamps to the conduits/adaptable boxes. (See clause 3.4).

2.3.1 In addition to the above where appropriate i.e. where cables are terminated in plain hole boxes then consider the use of proprietary male/female cable gland arrangements.

2.4 Insulate cable tails with sleeving to suit the prevailing temperature conditions.

2.4.1 Ensure sleeving for tungsten luminaires is of the medium temperature range for use up to 185 C. Ensure live conductors have black sleeving and protective conductor tails green/yellow sleeving. Ensure phase conductors have a red marker on the sleeve. Ensure sleeving is anchored and sealed to the pot.

2.4.2 Provide patent protective conductor tails where glands are omitted (see Clause 3.4).

2.4.3 Fit all pots with protective conductors braised by the manufacturer to each pot and suitably sleeve.

3.0 BOXES

3.1 Ensure all boxes used for terminating or jointing MICCV cables are conduit boxes Class 2 or Class 4, as required, complying with B.S. 4568.

3.2 For all lighting points, install boxes of the 'terminal', through, 'tee', or 'crossing' circular patterns.

3.3 In other cases use metal boxes of malleable iron or heavy duty steel with welded joints used. Ensure steel boxes shall have lugs suitably tapped to receive brass cover fixing screws (not self-tapping). Provide covers for each box unless an accessory or fitting is mounted over.

3.4 For concealed installations you may use conduit boxes incorporating a proprietary MICCV clamp securely fixing the pots to the box, but patent protective conductor tails will be required.

3.5 Ensure boxes are stove enamel or air drying paint inside and outside, and this applies to general installation work requiring Class 2 protection.

3.6 Where Class 4 protection is required, i.e. kitchens, plant rooms, tank rooms, boiler rooms, buried in ground or in other areas subject to dampness, ensure all boxes are hot dip zinc coated or galvanised with suitable machine surfaced or weatherproof sealed covers.

3.7 Ensure boxes in exterior locations, or subject to continual dampness, have external fixing lugs.

3.8 Ensure conduit boxes have terminal blocks supplied and fixed where used as junction boxes with permissible cable joints. Ensure terminal blocks have brass connectors shrouded in porcelain or heat resisting material capable of withstanding, without deterioration, the same temperatures as the pots, insulation and sleeving. Ensure the box is of a size to allow for the terminal block and to facilitate neat connections.

3.9 Ensure all conduits, accessories, or adaptable boxes, to which flexible cables, or flexible conduits are fitted, or upon which accessories or equipment are mounted, have earthing terminals provided and are securely fixed to the box.

4.0 INSTALLATION OF MICCV CABLES

4.1 Ensure MICCV cables are installed by tradesmen who have received a course of instruction on the handling, jointing and termination of MICCV cables.

4.1.1 Ensure the tradesmen are also fully instructed in the use of the specialist tools recommended by the manufacturer, which are to be used on the installation.

4.2 Secure cables by means of PVC served copper saddles using 30mm x No. 8 roundhead brass screws. Use multiple saddles where several cables are installed together.

4.2.1 The maximum spacing of fixings shall be:-

Overall diameter of MICS Cable	Maximum Horizontal Spacing	Maximum Vertical Spacing
Up to 9mm	600mm	800mm
Above 9mm and up to 15mm	900mm	1200mm
Above 15mm and up to 20mm	1500mm	2000mm

4.2.2 Ensure where unserved cables are specified in the particular specification the saddles are made of copper.

4.3 Protect MICCV cable to a height of 300mm by conduit or trunking when rising on the surface from the floor. Wherever there is a possibility of heavy equipment traffic increase this protected height to 2m.

4.3.1 Where MICCV cables are to be concealed in walls fully protect them by means of galvanised metal capping.

4.4 Where cables terminate at a surface or flush box with a drilled entry then refer to clause 2.3 for details of gland pattern. This does not apply to spout boxes.

4.5 Ensure that where surface mounted equipment is installed on a concealed MICCV installation the cables terminate in a flush mounted circular box, and the back of the equipment is drilled and bushed for back entry. Then install the equipment over to conceal the box.

4.5.1 Bend cable conductors of 2.5 sq mm or less back upon themselves for termination in screw or clamp terminals. Use cone grip type cable sockets or approved compression type cable sockets for all bolted connections.

4.6 Terminate all conductors requiring bolted connections with compression lugs using an automatic compression tool which will only release after the correct crimp depth has been obtained. Do not use soldered connections or lugs.

4.7 Ensure cables are installed neatly on the surface and routes are truly horizontal, vertical or parallel with the features of the building.

4.8 Where it has been defined in the particular specification that cables shall be laid in floor screeds then carefully plan the routes to avoid areas where there is a possibility of floor fixings. Particularly avoid centres and edges of doorways to allow for the fixings and closure of bolts. Ensure crossings in screed are shall be kept to a minimum and have at least a 25mm cover.

4.9 Where the use of cable tray is required for multiple routes, install the tray in accordance with Part 4 of this section do not allow unserved cables to be in contact with galvanised tray. Fix saddles using brass round head screws and nuts.

4.10 Where connections are made to:-

4.10.1 Equipment subject to vibration.

4.10.2 Equipment subject to adjustment or withdrawing.

4.10.3 Motorised valves, thermostats, control sensors, oil burners, etc.

4.10.4 Terminate the cables with an appropriate adaptable box sited adjacent to the item being connected and enclose the final connection from the box in metallic flexible conduit.

4.11 Test all MICCV cable seals for insulation resistance on completion of the seals at both ends of the cable within 24 hours after completion and ensure the test proves an infinity reading using a 500 volt d.c. test.

4.12 Ensure all cables are neatly installed, straightened and suitably dressed with rollers etc., to give a neat and workmanlike installation.

4.13 At terminating positions, arrange cable conductors to minimise crossing.

4.14 Fit surge suppressor to all cable ends connected to motors with star connection up to and including 2kW size.

5.0 INSTALLATION OF MICCV CABLES - UNDERGROUND

5.1 Bury cables to a minimum depth of 600mm to the top of the cable in unmade ground and 800mm minimum in made up ground, i.e. roadways, etc.

5.2 Rest cables on a 50mm deep bed of sifted sand and riddled earth and then cover with a further depth of 50mm of the same material.

5.3 Install two layers of permanently coloured yellow PVC marker tape 150mm wide along the entire length of the cable. Place the lower layer 50mm above the cable and the higher layer 300mm above. Mark the tape "ELECTRIC CABLE BELOW - CAUTION" in black lettering printed continuously along its length.

5.4 Ensure backfilling does not contain stone, brick, or any shape material and is fully consolidated by means of a rammer to the 300mm level before the second tape is laid. Only then carry out the final backfill to ground level and suitably consolidate.

5.5 Install earthenware type cable conduits under roadways and for building access, or wherever specified in the following section. Ensure the provisions are as specified above, and the depths requested are to the top of the conduit in all areas.

5.6 Ensure earthenware type cable conduits are salt glazed earthenware or heavy duty plastic socket and spigot type. Seal all ends of conduits around the cable by a waterproof and gasproof seal of self extinguishing plastic foam of the type approved by the Electricity Council.

5.7 Ensure any spare conduits shall have suitable end caps and be complete with draw wires.

5.8 Ensure MICCV cables installed direct-in-ground have a minimum spacing of 300mm from HV/EHV cables; 600mm from communication cables, alarm cables and gas services, and 800mm from any heating services.

5.9 Where it is not possible to comply with the depths specified, then set the conduits in concrete, as specified above.

5.10 Install cable route markers where cables are laid in grass verges, paved areas etc. Space the cable route markers at 45m intervals on straight routes, also place over all tee joints, changes of direction, where cables cross roads, and at building entries. Ensure markers are of proprietary type and 200mm square x 50mm deep concrete with plastic inserts indicating the depth and voltage of the cable(s) and are laid level with the finished surface.

6.0 MICCV CABLE SIZING AND CIRCUITING

6.1 Ensure cable sizes and cores are as specified in the following Section, or as shown on the drawings or wiring diagrams. Here they are not shown then size in accordance with the following:-

All MICCV cables in accordance with the ratings as in the relevant Tables of the 17th Edition of the IET Wiring Regulations.

Do not use cable less than 1.5 sq mm.

Connect socket outlets, connection units, and other appliances to 'ring main' or 'radial' circuits minimum cable size of 2.5 sq mm and 4.0sq mm respectively, in accordance with the 17th Edition of the IET Wiring Regulations. The following Section will designate special areas where voltage drop requirements are abnormal.

6.2 Fit appropriate cable colour indication oversleeving to suit circuit arrangements and the requirements of the IET Rules and Regulations.

PART 10 - LSF INSULATED AND SHEATHED CABLES AND INSTALLATIONS

Clause	Description
1.0	MATERIALS
2.0	GENERAL CLAUSES APPLICABLE TO ALL PVC INSULATED AND SHEATHED CABLE INSTALLATIONS
3.0	PVC INSULATED AND SHEATHED CABLE SURFACE INSTALLATION
4.0	PVC INSULATED AND SHEATHED CABLE CONCEALED INSTALLATION
5.0	EARTHING
6.0	PVC INSULATED AND SHEATHED CABLES - CABLE SIZING AND CIRCULATING

PART 10 - LSF INSULATED AND SHEATHED CABLES AND INSTALLATIONS

1.0 MATERIALS

1.1 Ensure cables are LSF insulated and sheathed complying to B.S. 6746 up to and including 35 sq mm.

1.2 Ensure no conductor less than 1.5 sq mm is used. Ensure cables have copper conductors, twin core and combined circuit protective conductor (CPC) with white PVC sheath; conductors are multi-stranded for cable of 4mm size and above.

1.3 Exercise care in selecting cable sizes to ensure that the cross sectional area of the combined circuit protective conductor complies with the 17th Edition of the IET Wiring Regulations (see paragraph 5.0 "EARTHING" below).

1.4 Provide accessory boxes for all accessories. Ensure that where used in concealed installations, boxes are rustproof, metallic boxes with bushed cable entry and adjustable alignment lugs.

1.5 Where used in surface installations, ensure boxes are of white coloured plastic to match the accessory.

1.6 Ensure all boxes have fitted earth terminals and are 25mm deep for lighting accessories and 35mm deep socket outlets/fused connectors. Ensure boxes comply generally with B.S. 4662.

2.0 GENERAL CLAUSES APPLICABLE TO ALL LSF INSULATED AND SHEATHED CABLE INSTALLATIONS

2.1 Ensure the installations are surface or concealed as specified in the following part, and comply in all respects to the 17th Edition of the IET Wiring Regulations.

2.2 Fix all cables as required by Table 4A of the 17th Edition of the IET Wiring Regulations, using LSF single pin or saddle clips.

2.2.1 Ensure the fixing of boxes is by 30mm x No. 8 steel screws using a proprietary fixing method. Accessory boxes up to and including 75mm x 75mm have 2 No. fixings. Switch boxes larger than 75mm x 75mm have 4 No. fixings.

2.3 Fully enter all cable sheaths into the box via a rubber insert bush and web. Ensure the protective conductor has green/yellow sleeving where connecting to the earthing terminal. Install a separate green/yellow sleeved protective conductor from the box earthing terminal to the earthing terminal of the accessory or appliance.

2.3.1 In Class 4 areas, use packed glands with neoprene washers in lieu of the rubber insert bushes.

2.4 Wire lighting circuits on the three plate rose system and socket outlets/fuse connectors on ring main systems unless otherwise specified in the following Part.

2.5 Where bolted connections are required, fit connection lugs by compression using an automatic tool which cannot be released until the correct pressure and crimp depth is obtained.

2.6 Never allow LSF cables to come in contact with any form of polystyrene.

3.0 LSF INSULTED AND SHEATHED CABLE - SURFACE INSTALLATION

3.1 Install cables as inconspicuously as possible, taking advantage of the features of the building by fixing in corners, behind or along skirting boards, mouldings etc. and behind fitments etc.

3.2 Where rising from the floor protect the cables by metal conduit or channel to 300mm height, or in the case of areas where heavy equipment traffic is envisaged increase the protection height to 2m.

3.3 Where wiring terminates at a luminaire other than a ceiling rose for a plain pendant, sleeve the cores with heat resistant sleeving from the point of entry into the luminaire and up to the terminals.

4.0 LSF INSULATED AND SHEATHED CABLES – CONCEALED INSTALLATIONS

4.1 Where concealed in walls, lay the cables in the plaster finish and protect by oval non-metallic conduit which should enter accessory boxes.

4.2 When under timber or chipboard floors, do not notch the joists but drill at right angles 50mm below the floor level to allow the passage of cables. Keep hole sizes to a minimum, but of sufficient size to avoid cold running.

4.3 In hollow partitions patent fixings may be used.

4.4 Terminate all lighting points in a plastic PVC ceiling rose box mounted flush to ceiling. Ensure the box is heavy gauge self extinguishing PVC to B.S. 4607 reinforced with tapped metal inserts. Provide a fixed terminal block and heat resisting cables or use sleeves to connect the luminaire.

4.5 Direct wiring to ceiling roses will be permitted where pendants are specified. Securely fix the box to a joist or to timber noggings using 2 No. fixings.

4.6 Ensure cables in roof spaces are clipped to the sides of joists and where traversing joists, provide and fix binder joists or suitable battens

4.7 Ensure all cables are neatly installed, dressed to give a neat and workmanlike installation.

5.0 EARTHING

5.1 Ensure that normally earthing is to the earthing terminal supplied by the Electricity Supply Authority, using green / yellow sleeved cable sized to the 17th Edition of the IET Wiring Regulations. If any other system is required this will be specified in the particular specification.

5.2 Bond all other services, i.e. gas, water, etc., at the point of entry to the main earth using green/yellow sleeved cable and proprietary earth clamps of the adjustable strap type with independent terminals. Ensure equipotential bonding in bathrooms etc., is in accordance with the 17th Edition of the IET Wiring Regulations.

5.3 Note the local Electricity Supply Authority's Regulations regarding PME (TNCS) installations and comply with these Regulations and the 17th Edition of the IET Wiring Regulations in this regard.

5.4 Ensure that the selection of combined protective conductor sizes shall be carried our in accordance with Table 54G or calculated in accordance with Regulation 543-2 of the 17th Edition of the IET Wiring Regulations.

6.0 LSF INSULATED AND SHEATHED CABLES - CABLE SIZING AND CIRCUITING

6.1 Ensure cable sizes are as specified in the following Parts, or shown on the drawings or wiring diagrams. When these are not shown, ensure they are sized in accordance with the ratings for the appropriate cables as outlined in the relevant Tables of the 17th Edition of the IET Wiring Regulations.

6.2 Do not use cable less than 1.5 sq mm unless specified in the following Part.

6.3 Ensure socket outlets, connection units and other appliances are connected to 2.5 sq mm ring main or 4.0 sq mm (minimum) radial circuits and are in accordance with the 17th Edition of the IET Wiring Regulations.

6.4 Where cables cannot be installed in areas avoiding the use, or likely use, of thermal insulating material, carry out the sizing of all cable using a thermal insulation factor complying with the 17th Edition IET Wiring Regulations 522-6 and table 52A.

PART 11 - ARMOURED CABLES - LSF/PVC/XLPE INSULATED -LOW VOLTAGE

Clause	Description
1.0	CABLES
2.0	STRAIGHT JOINTS, TEES AND BREECHES
3.0	CABLE TERMINATIONS
4.0	CORE TERMINATIONS AND JOINTING
5.0	INSTALLATION OF ARMOURED PVC/XLPE INSULTED CABLES
6.0	INSTALLATION OF ARMOURED PVC/XLPE INSULATED CABLES - UNDERGROUND

PART 11 - ARMOURED CABLES - LSF/PVC/XLPE INSULATED - LOW VOLTAGE

1.0 CABLES

1.1 For exact details of the copper or aluminium conductor types/sizes refer to the particular specification. However, if not defined then include copper conductors in the tender cost.

1.1.1 Ensure PVC/SWA/PVC cables are with copper conductors, PVC compound insulated, PVC bedding, single steel wire armoured and black PVC sheathed overall, 600/1000 volt grade in accordance with B.S. 6346 and B.S. 6360.

1.1.2 Ensure PVC/AL.S/PVC cables are with aluminium conductors, PVC compound insulated, PVC bedding, armoured with a single layer or aluminium strips or single steel wire and black PVC sheathed overall, 600/1000 volt grade in accordance with B.S 6346 and B.S 6360.

1.1.3 Ensure XLPE/SWA/PVC cables are with copper conductors, XLPE compound insulated, pvc bedding, aroused with a single layer of aluminium strips or single steel wire and armoured and black PVC sheath 600/1000V grade in accordance with B.S. 5467.

1.1.4 Ensure XLPE/SWA/LSF cables are with copper conductors, XLPE compound insulted, LSF (low smoke and fume) bedding, single steel wire armored and LSF sheathed overall, 600/1000 Volt grade generally in accordance with B.S. 5467 and 6724.

1.2 Where cable sizes are not detailed then size these in accordance with the appropriate current ratings in the relevant tables of the 17th Edition of the IET Wiring Regulations taking of the 17th Edition of the IET factors that are required i.e. volt drop, grouping factor, ambient temperature etc. Ensure the impedance of the armouring is no more than twice that of one of the live conductors. If this cannot be achieved then install additional CPC conductors. Ensure the neutral conductor is of the same size as the phase conductor(s).

1.3 Ensure all cables are of the same manufacture and wherever possible are delivered to site in manufacturer's standard lengths complete with end caps.

1.4 Subject cables at the manufacturer's works to the routine tests detailed in B.S. 6346 and BS. 5467. Submit duplicate copies of the Test Certificates to the Engineer for perusal and comment.

1.5 After the cable has been installed and jointed, carry out the voltage tests detailed in B.S. 6346 and B.S. 5467 in the presence of the Engineer.

1.6 Ensure single core cables operating on a.c. systems do not have steel wire armouring.

2.0 STRAIGHT JOINTS, TEES AND BREECHES

2.1 Make all underground joints for PVC/XLPE insulted cables by using a proprietary cast resin kit system supplied by one manufacturer and install strictly in accordance with their instructions.

2.2 Provide copper bonds within the joint to maintain full earth continuity. Ensure the resistance is no greater than that of the live conductors and the insulation resistance between cores, and between cores and earth, is no less than that of the original cable.

3.0 CABLE TERMINATIONS

3.1 Supply cable glands for connection to all apparatus required to be connected, whether or not the apparatus is to be supplied by others.

3.1.1 On cable terminations for steel armoured cables use brass compression glands with screwed male electric threads for fixing to switchgear etc., and shall comply with B.S. 6121.

3.1.2 Use aluminium alloy glands for aluminium strip armoured cables.

3.1.3 In general, carry cable cores direct to the terminals of the equipment to be connected, and joint short lengths of cable or cable tails to the cable cores.

3.1.4 Where single cables are installed use non-ferrous material for separation on termination, routing and cable gland plates.

3.2 Install suitable seals to provide a moisture-proof seal between the bush and the outer serving, and the bush and the inner sheath. Ensure glands have core grip armour clamps with suitable provision for cross joint bonding.

3.3 Ensure all cable joints and connections are electrically and mechanically sound.

4.0 CORE TERMINATIONS AND JOINTING

4.1 Ensure all conductor terminations are created by compression joints which are only made by tradesmen who have undergone a course of instruction from the manufacturer and are fully experienced with the method.

4.1.1 Ensure the environmental conditions for jointing are such that the work can be carried out without detriment to the completed joint.

4.1.2 Make the compression crimp connections by a purpose made automatic machine ensuring that a crimp, once started, cannot be released until full pressure and the correct crimp depth has been obtained.

4.2 Make the joints by compression type ferrules and wrap in the correct colour coded PVC insulation tape bound to the thickness of the original conductor insulation. Use only tight fitting heat shrink-on sleeves if the moisture resistance and insulation properties are that of the original cable.

4.2.1 Be responsible for all phasing out prior to the commencement of jointing. If inspection and subsequent tests show incorrect phasing, rectify and reconstruct the joints to the satisfaction of the Engineer at no additional charge.

4.2.2 In exceptional cases where long or flexible tails are required, or where operating conditions require special application, extended tails may be used, providing prior agreement of the Engineer obtained. Insulate the tails with materials suitable for all conditions in which they are used. Ensure the tails are of the same current - carrying capacities as the cable cores and jointed to the cores by means of either weak-backed ferrules, solidly sweated, or pressure solderless type connectors, and suitable tape to the original insulation standard. Ensure all connectors or ferrules are made of materials suitable in size and shape for the type of cable core used.

4.3 Ensure all bolted terminations have suitable compression type lugs of the correct size with bolts and shakeproof washers.

4.4 Ensure conductors over 10 sq mm where received by tunnel type connections of the pinch screw type have pin lugs.

4.5 Ensure the collars of all lugs and the non-conducting parts are wrapped in PVC colour coded tape to the original conductor insulation thickness.

4.6 Ensure all insulating tape complies with B.S. 3924.

5.0 INSTALLATION OF ARMOURED XLPE/PVC/XLPE INSULATED CABLES

5.1 Install cables as indicated on the drawings and detailed in the following Section.

5.1.1 Arrange cable routes so that cables, hangers, cleats etc., do not come into contact with, or in close proximity to, piped services. Space to the requirements of the 17th Edition of the IET Wiring Regulations. Check all routes on site for correct measurements and practicability. Co-operate with other trades and ensure close liaison to avoid clashes of services and prevent mechanical damage to cables.

5.2 Ensure cable routes, where fixed on walls or in accessible ducts, are fixed at intervals to prevent sag in accordance with the manufacturer's recommendations and the 17th Edition of the IET Wiring Regulations. Where cables are installed in inaccessible ducts, refer to the following Parts.

5.2.1 Ensure cable sweeps and bends are within the permitted radius requirements of the manufacturer and clause 522-08 of the 17th Edition of the IET Wiring Regulations and are fully supported. Do not reduce minimum cable radii even when installation is taking place.

5.3 Unless otherwise specified, fix cable installation in air, including engineering service ducts, with the appropriate manufacturer's aluminium alloy or approved claw cleats with galvanised back straps using galvanised bolts conforming to B.S. 1490, with supports in accordance with Clause 522-08 of the IET Regulations. Fix cleats for cables up to and including 50mm diameter by a single bolt, and above 50mm diameter by 2 bolts. Provide the correct size of cleat fixing stud to suit the cable size, ensuring that the stud does not extend appreciably beyond the tightened nut. Avoid excess pressure of cleats on the serving of each cable to prevent deformation of the sheathing. Provide suitable supporting steelwork and/or galvanised cable tray where cables cross open spaces. Protect such steelwork by a rust inhibiting paint.

5.3.1 Fix using expanding masonry bolts or equal, and agreed by the Engineer. Allow for all holes and making good associated with cable fixings.

5.4 Fix cables lay in racks, hangers or, on steelwork at intervals to prevent sag, in accordance with the 17th Edition of the IET Wiring Regulations. Take care to avoid damaging the serving of all cables being installed.

5.4.1 Obtain approval from the Engineer before installing racks and hangers and for any non standard equipment.

5.5 Ensure all joints have the armouring bonded across and at termination points are bonded to the switchgear. Use copper conductors of the correct size in accordance with Table 54G of the 17th Edition of the IET Wiring Regulations.

5.6 Ensure cables passing through walls and floors have oversized sleeves permanently fixed, packed with a fire-resisting infill. Where cables rise or fall on walls, protect to a height of 2m with a sheet steel guard.

5.7 Ensure all cable are neatly installed, straightened and dressed to give a neat workmanlike installation.

6.0 INSTALLATION OF ARMOURED LSF/PVC/XLPE INSULATED CABLES - UNDERGROUND

6.1 Bury cables to a depth of 600mm to the top of the cable in unmade ground and 800mm in made up ground, i.e. roadways etc.

6.2 Rest cables on a 50mm deep bed of sifted sand or riddled earth and then be cover by a further 50mm depth of the same material.

6.2.1 Complete underground joints using cast iron boxes, then paint with two coats bitumastic paint.

6.3 Install two layers of permanently coloured yellow PVC marker tape, 150mm wide, along the length of the cable. Place the lower layer 50mm above the cable and the higher layer 300mm above.

6.4 Ensure backfilling does not contain any stone, brick or sharp material and is fully consolidated with a rammer to the 300mm level before the second tape is laid. Carry out the final backfill to ground level and suitably consolidate.

6.5 Ensure that where it is necessary for LSF sheathed cables to be installed in the ground then this is carried out strictly in accordance with the respective cable manufacturer's recommendations.

6.6 Ensure cables which follow the same route and are laid in the ground are of horizontal formation with spacing between cables, where possible, of not less than 150mm, with the exception of single-core cables which are laid in the foil formation and touch along their entire length. Indicate each group of cables by separate marker tapes.

6.7 Install earthenware type cable conduits under roadways, crossing roadways and crossing roadways, and for building access to wherever specified in the following Section. Ensure the provisions are as specified above, and the depths are to the top of the conduit.

6.8 Ensure earthenware type cable conduits ducts are of smooth bore vitrified clay or heavy duty plastic socket and spigot type. Seal all ends of conduit around the cable with a waterproof and gas proof seal of self-extinguishing plastic foam of the type approved by the Electricity Council.

6.9 Ensure any spare Earthenware type cable conduit has suitable end caps.

6.10 Ensure low voltage cables installed direct-in-ground have a minimum spacing of 300mm from HV/EHV cables; 600mm from communication cables, alarm cables, and gas services; and 800mm from heating services.

6.11 Where it is not possible to comply with the depths specified, set the conduits in concrete.

6.12 Provide and install cable route markers where cables are laid in grass verges, paved areas, etc.

6.13 Space the cable route markers at 45m intervals on straight routes and over all tee joints, changes of direction, where cables cross roads and at building entries.

6.13.1 Ensure markers are of a proprietary type 200mm square x 50mm deep concrete, with plastic inserts indicating the depth and voltage of the cable(s). Lay markers level with the finished surface.

6.13.2 Lay markers level with the finished surface.

PART 12 - SWITCHGEAR AND LV PANELS

Clause	Description
1.0	SWITCHGEAR - 500 VOLTS (AIR CIRCUIT BREAKERS, MOULDED CASE CIRCUIT BREAKERS, FUSE SWITCHES, SWITCHFUSES AND ISOLATORS).
2.0	SWITCHGEAR - 250 VOLTS
3.0	CONSUMER UNITS
4.0	RESIDUAL CURRENT-OPERATED CIRCUIT BREAKERS
5.0	HRC FUSE DISTRIBUTION BOARDS
6.0	MCB DISTRIBUTION BOARDS
7.0	POWER FACTOR CORRECTION EQUIPMENT
8.0	UNIT TYPE SWITCHBOARDS
9.0	CUBICLE TYPE SWITCHBOARDS
10.0	DRAWINGS
11.0	TERMINATION AND SWITCHBOARD CONNECTIONS
12.0	SAFETY AND MAINTENANCE ASPECTS
13.0	IDENTIFICATION AND NOTICES
14.0	PHASE COLOURING
15.0	CURRENT TRANSFORMERS AND INSTRUMENTS
16.0	METERING
17.0	TESTING
18.0	DOCUMENTATION

PART 12 SWITCHGEAR AND LV PANELS

1.0 SWITCHGEAR - 500 VOLTS (AIR CIRCUIT BREAKERS, MOULDED CASE CIRCUIT BREAKERS, FUSE SWITCHES SWITCHFUSES AND ISOLATORS

1.1 Unless otherwise specified in the particular specification or on the drawings, the contract is deemed to include the supply, delivery, off loading, erection, connection, testing and commissioning all loose switchgear, manufactured panels and 'on-site' constructed panels in the locations defined on the drawings and in the particular specification.

1.2 Ensure switchgear is if the 500 volt rating, metalclad, (unless otherwise stated in the particular specification) totally enclosed, surface-mounted contained within unit form panels or cubicle panels as defined in the particular specification or on the drawings and complies fully with the appropriate requirements of BS 4752, 4794, 5419, 5424, 5472 and 5486.

1.2.1 Ensure short circuits ratings, current ratings, number of poles and fusing arrangements are as indicated on the drawings and/or in the particular specification.

1.2.2. Contain the neutral connection/link of each ACB, MCCB, fuse switch, switchfuse and isolator within its respective enclosure/moulding (unless otherwise indicated on the drawings and or on the particular specification).

1.2.3 Ensure that where multi-pole isolators are specified these are as defined in clause 1.2 but comply with BS 5419, (Category AC23). Unless otherwise specified in this specification or on the drawings control all machines by an isolator or isolating switches as the case may be complete with final connections to respective items of equipment.:

1.2.4 Ensure fuse links comply with BS 88, are of high breaking capacity unless specified in the following section, and are of the make and rating specified in the Schedule and Drawings. Fit fuse carriers rated at 200A and over with wedge or bolted contacts. Provide spare fuses of the number and sizes specified.

1.3 Provide the selected manufacturers of panels etc, with details of all cable sizes, types and switchgear and panel locations , both during tender enquiry and post tender periods, so that if necessary, panels, switch unit sizes and termination etc. can be adjusted to suit the particular contracts needs.. Include all costs associated with the above in the tender.

2.0 SWITCHGEAR - 250 VOLTS

2.1 Note that normally all switchgear is of 500 volts as specified, but 250 volts gear is permitted in single phase installations if there are no other phases are present in the room within 2m.

2.2 Consumer units are permissible in the above circumstances, but use 500 volt distribution boards if it forms part of a switchpanel where other phases present.

3.0 CONSUMER UNITS

3.1 Ensure consumer units are 250 volts rating and conform to BS 5486: Part 1 and 13.

3.2 Ensure circuit protection is given to the circuits as indicated in the drawings or the particular specification.

3.3 Ensure consumer units are, unless indicated otherwise on the drawings or in the particular specification surface-mounting pattern complete with a suitably sized integral double pole isolator. Ensure the unit is complete with multi-connection earth and neutral terminal bars with a separate connection fort each conductor.

3.4 Carry out neutral and earthing connections to the termination bars so that the respective circuit neutral and earth wires follow the same pattern and direction as those of the phase conductors.

4.0 RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCCB)

4.1 Install RCCB units complete either as components with distribution boards or self contained units complete with enclosures, mounted as loose switchgear controlling circuits or distribution boards as the case may be.

4.2 Ensure all RCCB units comply fully with the requirements of BS 4293, and are of the sensitivities, load ratings and pole configurations detailed in the particular specification or as defined on the drawings. Note that unless otherwise stated, the sensitivity of RCCB units shall be 30mA.

4.3 Adhere to the selected manufacturers installation/connection requirements at all times and after completion of the works test each unit to ensure that the respective breaker trips lie within the time limits recommended for the category of breaker.

5.0 HRC FUSE DISTRIBUTION BOARDS

5.1 Ensure these are surface metalclad 500 volts with the number of and fuse ratings as shown on the drawings and/or detailed in the following section. Ensure they are of the same finished colour and manufacture as the main switchgear/panels selected for the works and conform BS 5486: Part II.

5.1.1 Ensure circuit protection is of the cartridge type complying to BS 88. Ensure each way has a terminal on the neutral bars giving identification of the circuit served.

5.1.2 Ensure that adequate provision is made within the distribution board to receive the specified cabling and that the boards are physically sized to suit the proposed installation location.

5.3 Ensure ingress protection is a minimum of IP31 rating with all cable entries into the boards maintained at this protection rating.

5.4 Mount distribution boards so that they are readily accessible and fix firmly to the building fabric by rawlbolts or other approved fixing, or to metal framework by nuts, bolts and washers.

5.5 Ensure the board enclosures are suitable for surface or flush installations on walls, as indicated on the drawings, and are suitable to accept the necessary trunking/conduit entries for outgoing circuits. Line trunking entries with neoprene or similar material to prevent damage to cables.

6.0 MCB DISTRIBUTION BOARDS

6.1 Ensure miniature circuit breaker boards are similar to HRC fuse distribution boards, except that they should comply with BS 5486: Part 12 and be supplied complete with MCB's of the size detailed on the appropriate drawings/schedules in the particular specification.

6.2 Ensure MCB's conform to BS 3871 Type 3, M1 - M9 and/or as defined in the particular specification or on the drawings.

6.3 Ensure the miniature circuit breakers incorporate thermetically sealed time delay tripping mechanisms giving an inverse time/current characteristic for overload operation with instantaneous tripping or heavy overloads or short circuits.

6.4 Securely clamp the miniature circuit breakers to busbars, or install the plug in type, as specified in the Schedule.

6.5 Ensure miniature circuit breakers are of the types and rating specified, complying with BS 3871: Part 1, and include both thermal and magnetic overloads.

6.6 Operate the miniature circuit breakers within the temperature range 0 C to 40 C without any out of tolerance alteration in the operated time/current characteristics.

7.0 POWER FACTOR CORRECTION EQUIPMENT

7.1 Install automatic power factor correction equipment in the locations defined, contained within appropriate enclosures and of the ratings as shown on the drawings or as specified in the particular specification. Unless otherwise stated, design each assembly of equipment to automatically maintain a corrected power factor of 0.91 minimum over a range of full load KVA of 20% - 100% and an uncorrected load power factor of 0.85 minimum in the circuits to which it is connected. Ensure the equipment consists of the following items:-

7.1.1 Unit capacitors each of suitable rating and contained in a sheet steel vacuum sealed enclosure complete with appropriate fixings, cable or conduit entries and terminations. Ensure the total KVA requirement consists of an appropriate assembly and interconnection of the required number of such units.

7.1.2 Capacitors suitable for operation of an 415 V, 3 phase, 50Hz supply in the ambient conditions specified.

7.1.3 Capacitors impregnated with high permittivity chlorinated diphenyl, non-flammable compound and capable of maintaining the KVAr output within the tolerances of 0% to +10% of their stated nominal rating.

7.1.4 Capacitors fitted with an automatic discharge device to achieve full discharge within one minute after disconnection.

7.1.5 A KVAr sensitive relay complete with any necessary current transformers and appropriate setting adjustments to suit the application and arranged to operate through a contactor(s) to automatically switch unit capacitors in and out as required to maintain the specified final power factor.

7.1.6 Each unit capacitor protected by an HRC fuse and connected via an isolator/fuse switch as the case may be.

7.1.7 Isolators and fuses for use on capacitor circuits by 33 1/3%. Air circuit breakers and contactors for use on capacitor circuits de-rated by 20%.

7.1.8 Unless otherwise defined in the particular specification ensure power factor equipment is automatically disconnected prior to the operation of standby generator(s).

8.0 UNIT TYPE SWITCHBOARDS

8.1 Ensure the panels consist of switchgear units and fusegear specified above, together with all matching cable boxes, terminations, conduits and wiring interconnections, and are as BS 5486 Forms 2, 3 and 4, as detailed in the particular specification. The relevant sections of BS 5419 and BS 5420 also apply.

8.2 Mount all switchgear and fusegear on an angle iron framework within the dimensions of the space shown in the drawings.

8.3 Where unit-type switchboards (and this comment shall also apply to cubicle boards) are sited over formed floor trenches then include for all necessary support steelwork to span trenches and also provide all floor/wall rawlbolt fixings that are recommended by the manufacturer or detailed in the

following sections. Others will provide exposed trench covers unless otherwise stated in the next section.

8.4 Ensure a busbar chamber is supplied and fixed the whole length of the switchboard and is readily extendable. Ensure bus bars have suitable copper bars and are of the minimum rating of the main incoming switch. Suitably colour code both on the bars and on the chamber cover.

8.5 Ensure connections between bus bars and respective switchgear and distribution gear are by copper bars, rods or copper cables suitably fixed with clamps and bolts.

8.6 Mount suitable cable trunking and a matching steel cabinet on the frame to accommodate metering, CT's and other equipment of the local Electricity Board.

8.7 Ensure instrumentation is as specified under clause 15.0 of this section.

8.8 Ensure each unit switchboard is complete with Protective Conductors bonding all components as set out in the 17th Edition of the IET Wiring Regulations. Also provide a main earth terminal.

8.9 No through wiring is allowed.

8.10 Assemble all unit switchboards from one manufacturers equipment and paint in one colour.

9.0 CUBICLE TYPE SWITCHBOARDS

9.1 Construct cubicle type switchboards in accordance with BS 5486 Forms 2, 3 and 4 (as outlined in the particular specification;) Appendix N2 and have fully shrouded busbars (in accordance with the appropriate British Standards) and accommodate the switchgear specified in the particular specification or as defined on the drawings.

9.1.1 Ensure panels are manufactured with a minium thickness of 16 gauge zintex-coated braced sheet steel finished with light grey epoxy-based paint on all surfaces and support frames etc. and protected to minimum IP 31.

9.1.2 Ensure that unless otherwise stated in the particular specification, panels shall be fully fault rated to a minimum level of 30kA for one second duration. Forward to the Engineers the appropriate panel test certificates.

9.1.3 Flush mount equipment and all maintenance, cabling and replacement, from the front unless otherwise specified in the particular specification.

9.1.4 Ensure all panels are supplied complete with the required quantities of ACB's, MCCB's and fuse switch units as shown on the drawings or detailed on the particular specification schedules including the appropriate quantities/types of HRC fuse links.

9.1.5 Unless otherwise stated in the following section fit all cubicle panel bases with 100mm high metal plinth.

9.2 Make the panels readily extendable and include spare panels as detailed in the particular specification to accommodate the metering equipment etc, for the Electricity Board and where specified house the appropriate power factor correction equipment/switchgear. Also include spare panels for switchgear as shown on the drawings or as detailed in the particular specification.

9.2.1 Provide panel sections with removable eye bolts in each corner for lifting purposes.

9.3 Make connection between busbars and all switchgear by means of copper bar/rod as the case may be, this will be dependent on fault rating and so, segregate the panel so that the maintenance on one item will not entail a shut-down on others.

9.4 Construct the main busbars, dropper bars and interconnections to each item of switchgear in accordance with the relevant part of BS 159, using solid drawn copper bars, complying with BS 1432 and fit with suitably shrouded covers for external cable connections.

9.4.1 Enclose busbars in an earthed metal chamber within the panel. ensure a removable metal cover provides an earthed barrier between the operator and the live connections. Ensure all busbars have a minimum current rating of that of the switchgear controlling the incoming supply to the panel.

9.4.2 Ensure all penetrations of live busbars into outgoing circuit compartments or cables chambers are fully shrouded to prevent accidental contact, and labelled accordingly.

9.5 Supply each panel complete with a suitably sized earth bar installed throughout the full length of the panel and fix directly to the steel framework. Provide this earth bar with appropriate bonding connections to each item of switchgear, all cable plates and the necessary connections for TNS earthing configuration.

9.5.1 Where a panel is to be delivered to site in sectionalised form for ease of installation or delivery, off loading etc, allow in the tender for the cost of the manufacturer to retest the panel on site including the reconnection of the panel sections, bar etc. Connect the individual sections of the earth bar together by approved means with copper straps of the same cross sectional area and shape in order to provide continuity and total integrity throughout the panel.

9.6 Control all outgoing circuits by means of fuse switches MCB's or ACB's as defined on the drawings or in the particular specification and comply fully with BS 5419. To permit the renewal of fuses, fully isolate the fuse carrier assemblies of fuse switches in the OFF positions , so that there is no risk of shock. Also fit MCCB's with locks in the OFF position.

9.6.1 Ensure all fuse switches have double break, silver or electro-tinned contacts, safety interlocks, ON/OFF indication and are suitable for padlocking in the OFF position. (Maximum 30kA fault level).

9.6.2 Ensure the RCB's and MCCB's installed in the LV panels comply in every respect with BS 4752.

9.6.3 Ensure all ACB's are of the withdrawable pattern complete with control/switching devices, interlocks, locks etc, and safety shutters which completely shroud the main fixed isolating contacts automatically when the breaker section is withdrawn.

9.6.4 Ensure operating handles for switchgear are of the rotary, toggle or retractable types as the case may be. Ensure switchgear has short-circuit ratings suitable for the distribution network requirements and is manufactured such that the cover cannot be removed while the switch is in the ON position.

9.6.5 Ensure that the manufacturers indicate on all fuse switches the characteristics (current rating, breaking capacity, cut off current and energy let through) of the fuses with which the fuse switch unit has been tested in combination.

9.6.6 Note that fuse switch units fitted with solid copper links both appropriately rated may be used as isolators for circuits up to 1600A. (Maximum 30kA fault level).

9.6.7 Note that fuses shall be rated for AC duty, and have a category of duties 550V AC 80kA Class Q1 and

comply with BS 88.

9.7 Include all cable tails for the Electricity Board cut-outs complete with suitable fixings or trunking enclosure as defined on the drawings.

9.8 Supply and fit labels to all switchgear, cable chamber covers and busbar covers with the appropriate designations or warning notices as necessary. Issue label schedules to the Engineers for their agreement of designation.

10.0 DRAWINGS

10.1 Submit drawings showing the proposed unit or cubicle type switchboards, including dimensions, proposed construction, layout, internal connections, identification markings etc, to the Engineer for comment before manufacture commences.

10.1.1 Provide to the manufacturers copies of the appropriate tender drawings during tender and post tender periods to ensure that all contingencies are included such as cable types and sizes, plant locations of panels etc.

11.0 TERMINATION AND SWITCHBOARD CONNECTIONS

11.1 Provide all switchgear with suitable means of receiving the types of cables and sizes they are controlling. In some circumstances a cable of a rating higher than the current rating required will be installed, therefore give due allowance whilst tendering for accommodation and manipulation.

1.1.1 Provide connection rail enclosures and cable gland plates for cubicle boards and where stated in the following section appropriate vertical cable compartments.

11.2 On all bolted terminations fit suitable compression lugs of the correct size to suit cables being installed, with bolt and shakeproof washers.

11.3 Ensure stranded conductors, where received by tunnel type connection of the pinch screw pattern with or without a pressure plate and where the conductor does not occupy 90% of the tunnel diameter, a soft copper ferrule is fitted to contain the conductor stranding under pressure of the pinch screws.

11.4 Ensure small wiring within the panel to BS 6231 using type 'B', PVC insulated 600V grade stranded copper conductors and has a cross section of not less than 1.5 sq mm.

11.4.1 Terminate wiring in readily accessible fully shrouded terminal rails adjacent to the instruments.

11.4.2 Ensure that where different voltages terminate in close proximity, then these are segregated and provided with insulated barrier plates between; terminal wiring is one in and one out. If it is found necessary to connect more wires, fit suitable cross bar connections to the extended terminals.

11.4.3 Ensure terminal rails are of the appropriate current rating and of sufficient size to suit the cable conductors being installed, are fitted with purpose made supports and are of robust construction, and further comply with the following:-

.1 The voltage rating is 500V.

.2 The rail is of asymmetrical mild steel aluminium.

.3 The terminal fixing to rails has spring loaded fronts, i.e. retention is not dependent only on the terminal mouldings.

.4 Terminals are locked to the terminal rail.

.5 Clamps are of a design which gives anti-vibration facility with back-up spring(s), and are suitable for hook type crimps (high tensile carbon steel).

.6 Clamping screws are captive and of high tensile steel and operate against a plate to prevent damage to the conductor. Do not use pinch screws or push-on terminals.

.7 Insulation materials are carbon-free and suitable for operation at temperature of -5 C to 130 C continuous and are non-hygroscopic.

.8 Ensure safety features are designed to eliminate accidental contact by operation.

11.5 Ensure PVC. Insulated cables extend directly to switchgear/switchpanel terminals.

11.5.1 It is possible to take paper insulated cables direct to terminals of the switchgear/switchpanel if the "tail" from the sealing/entry box is no longer than 600mm.

11.5.2 Where paper insulated cable tails would be longer than 600mm, joint PVC tails of the same size as the cable and complying to BS 6231, to the paper insulated cable in accordance with manufacturers recommendations.

11.6 Do not route outgoing cables through the busbar chamber.

11.7 Where vertical cable chambers form part of the panel construction ensure that suitable cable gland plates are fitted to receive the respective cables, and appropriate termination shrouds are fitted. Bond the plates to the panel earth bar.

11.8 Ensure that where relays and multi-pole contactors are required to be accommodated with panel compartments these are fully equipped and wired accordingly to the terminal rails etc. and conform to BS 142 and BS 6360 respectively.

12.0 SAFETY AND MAINTENANCE ASPECTS

12.1 Particular attention is drawn to Chapter 53 of the 17th Edition of the IET Wiring Regulations.

12.2 Ensure all remote switch devices used for switching 'off' mechanical plant etc, for maintenance have facilities for padlocking (or similar approved method) the device in the "Off" position. Also ensure switches conform to tables I and II of BS 5419 Category AC23. Where the device is contained with other devices in an enclosure, e.g. distribution board then ensure the enclosure cover has padlocking facilities. Note the requirements of 476-4.

13.0 IDENTIFICATION AND NOTICES

13.1 Ensure all identifications and notices are carried out in accordance with Section 514 of the 17th Edition of the IET Wiring Regulations.

13.2 Fix Ivorine labels and warning notices of 75mm x 25mm minimum size, to each item of equipment using chromium plated screws.

13.2.1 Ensure all labels are white with in-filled "black" letter 6mm high.

13.2.2 Ensure warning notices are white with in red letters 20mm minimum high.

13.3 Ensure all necessary charts and tables are typewritten on a durable material and mounted in glazed, teak frames, fixed to the wall adjacent to the distribution board or within the distribution boards using a clear PVC envelope.

13.3.1 Ensure all charts and tables have one blank column in order that additions or alterations may take place without disfiguring the label.

13.3.2 Ensure the basic circuit chart for distribution board, etc follows the format of the circuit lists included in the following section and as outlined in Part 15, of this section.

14.0 PHASE COLOURING

14.1 Clearly mark all switchgear and distribution boards on the external vertical face by discs showing the phase and phase rotation, which is Red, Yellow, Blue and Black (neutral). Mark busbars with a tape band.

15.0 CURRENT TRANSFORMERS AND INSTRUMENTS

15.1 Where current transformers (CT's) are required ensure these shall comply fully with BS 3938 and unless otherwise stated have 5 Amp secondary. Ensure the rated VA output is suitable for the type and magnitude of the connected burden.

15.2 Ensure current transformers for metering and control purposes are of accuracy Class 3 minimum.

15.3 Ensure current transformers for protection purposes are of Class P5, P10 or X dependent upon the protection scheme.

15.4 Ensure the accuracy limit factor for P5 and P10 Ct's is appropriate for the protection scheme and greater than the highest available setting of any instantaneous element. Ensure the 'knee' point voltage of Class C CT's is sufficient for correct operation for the protection scheme and can maintain stability for 'through fault' conditions.

15.5 Use current transformers of the 'bar' primary type unless otherwise approved by the Engineers. Where sets of CT's are required then match them.

15.6 Terminate all connections from secondary windings at terminals integral with or adjacent to the CT's. Lace secondary windings and arrange to prevent contact with the 'main' circuit. Earth one terminal of the CT secondary circuit.

15.7 Note that isolating contacts in circuits between CT's and protective devices are not desirable. However, if the manufacturers require these, then obtain the Engineers written agreement. Note the removal of a protection relay from its case will 'short circuit' the connected CT.

15.8 Provide all protection relays with facilities for testing by 'secondary injection'. In the event that this facility is not afforded then provide a CT with a test winding, with terminals brought out to a suitable position to allow testing. Arrange a test winding such that injection of 10 Amp represents the full load current in the main circuit.

16.0 METERING

16.1 Ensure all indicating instruments are an approved manufacture and size in conformity with BS 89. Ensure the markings on the dials include the scale markings and the instrument transformer ratio; the manufacturers name and British Standard grading may be included in a position on the dial reading. Provide approved means for zero adjustment without dismantling the instrument. Ensure the minimum dial width is 72mm.

16.2 Flush-mount instruments.

16.3 Back-connect instruments with metal cases and earth.

16.4 Ensure instruments are of metric dimensions, have metric fixings and have a minimum terminal size of M4.

16.5 Where ammeters are specified ensure they are of the moving iron type and scaled so that the full load indication is at the min-point of the scale. Ensure the minimum reading under no circumstances is more than 10% of the full load. Connect ammeters, preferably of the long scale type (240 degrees), in the yellow phase unless a selector switch is specified.

16.6 Ensure that if selector switches for ammeters are specified they are of the 5-position type including OFF position to give the current values in each phase and in the neutral conductor.

16.7 Scale voltmeters so that the normal reading, which is marked with a red line, appears on 2/3 full scale defection. Complete with selector switches where specified.

16.8 Connect voltmeters having HRC fuses to the local bus bars via double insulated cables. Wiring from fuses to meters may be with single insulated cables. Enclose fuses within the respective panel compartment.

16.9 Ensure the location and general arrangement of meters is subject to the Engineers comment before manufacture commences.

16.10 Fit all incoming supply compartments with voltmeters and ammeters both with selector switches. This requirement also applies to alternative incoming supply compartments.

16.11 Fit all outgoing circuits of 400A and above with ammeters and selector switches as described unless otherwise specified in the particular specification.

16.12 Ensure where KWh/MD meters are requested in the following section these comply with BS 5685.

17.0 TESTING

17.1 Provide typed Test Certificates, including ASTA Certificates, for the class of switchgear to be supplied.

17.2 Make allowance for inspection visits to the works by the Engineers and the Employers Representatives.

17.3 Carry out all testing required on cables entering or leaving the panels as specified elsewhere, at such a time during the installation that satisfactory results can be obtained.

18.0 DOCUMENTATION

18.1 Submit a certified dimensioned outline drawing and schematic diagram for the Engineers perusal and comment before instructions are given to proceed with manufacture.

18.2 Unless otherwise stated in the specification, on completion of the works hand over, 2 No. sets of prints and one set of negative drawings of diagrams. Include maintenance instructions and the recommended list of spares in the operation and maintenance (O&M) manuals for the Employers retention.

PART 13 - EARTHING AND BONDING

Clause	Description
1.0	GENERAL
2.0	EARTH
3.0	MAIN EARTHING TERMINALS ETC.
4.0	SUBSTATION EARTHING
5.0	PROTECTIVE CONDUCTORS
6.0	TN-C-S SYSTEMS
7.0	EXTENSION AND ALTERATIONS TO EXISTING INSTALLATIONS
8.0	GENERATORS
9.0	EXTERNAL SOCKET OUTLETS AND EQUIPMENT

PART 13 - EARTHING AND BONDING

1.0 GENERAL

1.1 Install the whole of the earthing and bonding installations and test in accordance with the requirements of the 17th Edition of the IET Wiring Regulations, Local Supply Authority, this Specification, and in compliance with CP 1013.

1.2 Attention is drawn to Parts 2, 3, 5 and 6 of this Part regarding the use of circuit protective conductors, in addition to metallic conduit/trunking.

1.3 Ensure all enclosures, equipment, exposed conductive parts, extraneous conductive parts, lightning protection system, metallic trunking, metallic conduits, metallic cable trays and any other metalwork, other than any live part, forming protection or part of the electrical installation, including apparatus and appliances, are effectively bonded to earth and do not form part of the earth fault path of the protective conductor system.

1.3.1 Ensure all LV socket outlets have a green/yellow PVC insulated 2.5 sq mm stranded copper conductor as a 'fly lead' connected between earth terminals secured to both socket assembly and socket box.

1.3.2 Provide each lighting switch grid with an earth terminal and 'fly lead' as detailed above.

1.3.3 Provide hinged panels of switches, switchgear, control cubicles, distribution boards, etc, each with a 'fly lead' as described above route/protect the 'fly leads' to obviate damage to the cables when panels are opened and closed.

1.4 Provide protective conductors in the form of tinned copper tape for the full length of all busbar trunking systems. Ensure the size of this tape shall be in accordance with Table 54G of the 17th Edition of the IET Wiring Regulations, and is fixed externally to the side of the trunking using brass bolts and double (locking) nuts. Ensure maximum fixing centres are 900mm and each section of rising busbar trunking is effectively bonded to the tape.

1.4.1 Fit the protective conductor tape after the rising busbar system has been erected and allow the tape for the maximum length possible, minimising the number of joints. Allow for expansion of the busbar enclosure.

1.5 Ensure in addition, main water pipes, main gas pipes, other services pipes and ventilation ducting (including ductwork flexible connections, risers of central heating and air conditioning systems,) oil pipe services, storage tanks, piped gas systems etc, and the exposed metallic parts of the building structure are effectively connected to the main earthing terminal points using, where applicable, earthing clamps which conform to BS 951.

1.6 Ensure each building has all incoming services bonded to earth at their point of entry. For the purposes of this clause a building is defined as a separate structure. Structures linked by a corridor, subway or bridge are considered to be separate structures.

1.7 Bond together services entering/leaving plantrooms, boilerhouses, calorifier rooms, bathrooms, kitchens and other wet-process areas, and bond to the electrical installation protective conductor system.

1.8 Extraneous metalwork to be bonded includes:-

1.8.1 Exposed metal ceiling supports (if not otherwise detailed in the particular specification, or on the drawings), including bonding of main ceiling supports at 600mm centres along length of each room using 4 sq mm PVC insulated copper conductors.

1.8.2 Metallic balustrades and handrails.

1.8.3 Metallic ladders and companion ways.

1.8.4 Suspended metal floor systems including supports/frames.

1.8.5 All other exposed metallic parts and equipment permanently secured to or forming part of the building structure including exposed metalwork of hollow partitions and separate sections of duct/pipework insulation metallic covering.

1.8.6 The requirements of the above are to ensure that all exposed or extraneous conductive parts, having a resistance to earth of less than one megohm are bonded to the electrical services earth. Check all exposed or extraneous conductive parts and report to the Engineers any items which do not comply with this requirements.

1.9 Complete the protective conductor system prior to the energising of any item of plant or appliance, and before commencing earth bonding any other services to the protective conductor system, ensure that the protective conductor system is effectively connected to earth to prevent the other service(s) being the sole earth fault path.

1.10 Ensure that where copper tape is fixed to the building structure it is by means of purpose made'spacer bar' saddles, resulting in substantial fixing. Fixings requiring the drilling of holes through the tape will not be accepted.

1.11 Either tin joints in copper tape before assembly, riveted with a minimum of two copper rivets or use brass bolts and sweat solid. Use cadweld joints in strict accordance with the manufacturers instructions.

1.12 Ensure that where holes are drilled in the copper tape for connection to items to plant the effective cross sectional area of the connection is not less than that required to comply with IET Regulations. Where corrosion is likely then tin the surfaces.

1.13 Ensure bolts, nuts and washer for any fixing of the earth tapes are brass of the high tensile grade, or where liable to corrosion they are bronze.

1.14 Use the methods of earthing as given in the following Part.

2.0 EARTH

2.1 The earth is normally the earth terminals or earthed cable sheath of the Electricity Supply Authorities installation, provided the Authority has given written approval for the use of their earthing system for this purpose. Forward duplicate copies of the Supply Authorities written approval to the Engineer before the earth connection is made.

2.2 Where the following Part requires a connection to earth supplied by the consumer, install an earth electrode system to meet the site and soil conditions. This system shall comprise solid drawn high conductivity copper rods, 15mm diameter and 1200mm sections with hardened steel tips and driving

caps. Ensure depth of the driver rods are a minimum of 2400mm and the spacing is at least equal to their length. Ensure no electrode is within 3000mm of the building foundations.

2.2.1 Make connections by using proprietary clamps and provide with a concrete inspection pit with removable covers inscribed "EARTH" all by the same manufacturer as the copper rods.

2.3 Where reliable earthing cannot be obtained by either of these methods, refer to the following Part.

3.0 MAIN EARTHING TERMINALS

3.1 Provide main earthing terminals at all main incoming supply positions and connect to earth as detailed in the following Part. Where main and/or sub-main panels are required, ensure these also have an earthing terminal and are effectively connected to earth by an earthing conductor.

4.0 SUBSTATION EARTHING/CONNECTIONS TO SWITCHGEAR

4.1 Ensure the minimum earthing requirements for substation earthing and associated connections to switchgear etc. conform with CP. 1013 and as detailed in the following part/tender drawings.

4.2 Insulate the connection between the transformer neutral and the low voltage switchboard neutral busbar.

4.3 The position of the LV switchboard neutral conductor at which the earth connection is made depends on the system of earth leakage protection adopted, ie. as to whether it is on the mains or load side of the neutral current transformer - and is as specified on the drawings or in the schedules of the following part of this specification.

4.4 Main secondary connections of transformers may involve single core lead covered cables. If this is the case, then bond the lead sheaths in strict accordance with cable manufacturers instructions which will depend on the length of run. Bond the sheaths only at one end. At the other end mount the cable glands on insulated gland plates. Refer to following Part and/or LV schematic diagram for directions on whether bonding is at transformer or LV switchboard.

4.5 Unless otherwise specified in the following Part, install an earth electrode system to meet the site and soil conditions. This system comprises solid drawn high conductivity copper rods of proprietary manufacture, 15mm diameter and 1200mm section with internal screw and socket joints.

4.5.1 Fit sections with hardened steel tips and driving caps. Ensure the depth of driver rod is a minimum of 2400mm and the spacing is at least equal to the driver length. Ensure no electrode is within 3000mm of the building foundations.

4.6 Split the earth rod system into two halves, so that testing can be carried out on each half without loss of earthing facilities.

4.6.1 Bring back each half system to 400A testing links which serve as the main connection to the earth bar within the substation.

4.7 Ensure connections to the earth electrodes are readily accessible for periodic inspection, and protected against mechanical damage and corrosion. Make the actual connection to the rod by means of a purpose made clamp and lay below ground level in a concrete inspection pit having a removable cover prominently inscribed "Earth".

4.7 Where an earth electrode system is installed carry out soil resistivity and other tests, as described in the IET Wiring Regulations, to ensure that the required earth loop impedance figures are in accordance with the IET Regulations.

4.8

5.0 PROTECTIVE CONDUCTORS

5.1 Form these conductors wholly, or partially by:-

5.1.1 Copper circuit protective conductors with yellow/green insulation sized strictly in accordance with Table 54G of the 17th Editions of the IET Wiring Regulations.

5.1.2 Armouring and/or metal sheaths of armoured cable.

5.1.3 An integral protective conductor of any multi-core cable.

5.2 Unless specified in the following Part or shown on the schematic diagrams size the protective conductors in accordance with Table 54G of the 17th Edition of the IET Wiring Regulations, but not less than 1.5 sq mm.

5.2.1 Where PVC insulated and sheathed, twin and CPC systems are specified, see Part 10 of this Part for protective conductor size selection.

5.3 Terminate all bonding and protective conductors, where fixed to bolted connections, in compression type lugs made with an automatic purpose made machine.

5.4 Bond the metal sheaths and /or armouring of paper and PVC insulated cables to the metal parts of the equipment to which they are connected, utilising a proprietary brass earthing tag and brass nut and bolt.

5.5 When flexible conduit is used, ensure the protective conductor at the equipment end is made off to the equipment earth terminal. Install the protective conductor within the conduit and suitably size for the circuit(s) passing through.

6.0 TN-S-C SYSTEMS

6.1 Ensure that earthing, bonding and neutral switching isolation comply with the requirements of the 17th Edition of IET Wiring Regulations, the requirements of the protective multiple earthing approval 1974, and those of the Supply Authority.

7.0 EXTENSION AND ALTERATIONS TO EXISTING INSTALLATIONS

7.1 Check existing installations which are being extended to ensure that the existing earth continuity conductors and earthing leads comply with the IET Regulations.

7.2 Where a connection is made to another earth continuity conductor and earthing leads, supply and fix a permanent label indelibly marked with the words "SAFETY ELECTRICAL EARTH - DO NOT REMOVE".

8.0 GENERATORS

8.1 Install an independent earth electrode system conforming to the IET Wiring Regulations.

8.2 Connect an earth lead between the earth electrode/electrodes and the star point on the generator.

8.3 Bond the star point and metal framework of the generator to the local electricity board earth point (after obtaining their permission in writing) and/or the 'main' incoming earth point.

8.4 Ensure the size of the earthing lead and earth bonding leads are at least the same as the earthing lead of the installation, i.e. do not size according to the rating of the generator.

9.0 EXTERNAL SOCKET OUTLETS AND EQUIPMENT

9.1 Note that the term "External Socket Outlet and Equipment" applied to any socket outlet or equipment which itself is located outside the equipotential bonding zone of the main electrical installation or provided for the specific purpose or enabling mobile or portable equipment to be used outside this zone.

9.2 Protect all external socket outlets by a residual current device (RCD) having an operating current not greater than 30mA.

PART 14 - TESTING, INSPECTION AND COMMISSIONING

Clause	Description
1.0	GENERAL
2.0	PROCEDURES
3.0	CERTIFICATES AND SCHEDULES
4.0	LABELLING
5.0	RECORD DRAWINGS
6.0	OPERATING AND MAINTENANCE INSTRUCTION MANUALS
7.0	SPARES
8.0	SHOCK TREATMENT CARD
9.0	RUBBER MAT(S)
10.0	SPECIALIST TOOLS

PART 14 - TESTING, INSPECTION AND COMMISSIONING

1.0 GENERAL

1.1 Inspect and test the complete installation to ensure it complies with the requirements of this specification, the 17th Edition of the IET Wiring Regulations, British Standards, etc. Carry out the tests in accordance with Part 7 of the 17th Edition to the IET Wiring Regulations.

1.2 Carry out the inspection and tests in the same sequence as set out in the 17th Edition of the IET Wiring Regulations, unless otherwise agreed with the Engineer in writing, and in such time to allow any remedial work to be completed within the Contract Period. Ensure tests also include any part of an existing installation related to the new work.

1.3 Give reasonable notice to the Engineer of his inspection, commissioning and testing programme in order that the Engineer may be present to witness such procedure if so decided. Similarly, if it is deemed necessary, notify manufacturers representatives.

1.4 Supply all instruments. Ensure they are properly calibrated and operated by personnel trained and skilled in their use. Prior to commencement of tests ensure the Engineer is asked to comment on the suitability of the proposed test equipment and methods of testing being adopted.

1.5 Allow for disconnection or similar operations to satisfy the requirements for testing, etc, and the reinstatement of the installation.

2.0 PROCEDURES

2.1 Carry out the following procedures:-

2.2 A visual inspection, in accordance with Section 712 of the 17th Edition of the IET Wiring Regulations, including protection by electrical separation and by barriers or enclosures provide during erection; of equipment, crawlways, walkways, subways, ducts ceiling voids etc.

2.1.2 Ensure that any equipment physically damaged, whether the safety is impaired or not, rejected by the Engineer, is replaced free of charge, irrespective of whoever is responsible for the damage.

2.2 Check all accessories, equipment, control circuits, systems, RCCB's etc, and demonstrate for proper functioning. This includes fixed equipment supplied by others but wired under the Contract. Also verify RCCB operational clearing times.

2.3 Verify polarity on sockets, switches, light tracks, screw lampholders, and other items where correct polarity is essential.

2.4 Verify the continuity of conductors (including protective conductors, main and supplementary equipotential bonding) on final circuits.

2.5 Prove circuit identity of protective device, including neutrals and labelling complete.

2.6 Test the insulation resistance at 500V DC for all circuits above 50 volts up to 500 volts and 1000V DC for all other circuits. Phase to phase; phase to neutral; and phase to earth. Disconnect electronic components prior to tests.

2.7 Verify cable end markings and colours are required.

2.8 Carry out an extra low voltage continuity test to ensure a safe measure of earth bonding before the earth fault loop impedance tests are made.

2.9 Test the earth fault loop impedance and prospective fault current (IP) on each socket outlet, fused connector, fixed appliance, luminaire, switch and fuse gear and exposed metalwork bonded to earth. Ensure tests are phase/earth for all installations. Where RCCB's are connected to circuits, disconnect prior to the tests.

2.10 Test the earth electrodes resistance in accordance with CP 1013.

2.11 Test the insulation of site built switchgear assemblies.

2.12 Test the insulation of non conducting walls and floors, (where appropriate). Refer to clause 1.8 for further details.

2.13 Test the complete lightning protection system in accordance with BS 6651 (where appropriate).

3.0 CERTIFICATES AND SCHEDULES

3.1 Record all values called for under the 17th Edition of the IET Wiring Regulations and Clauses above, and give two copies of the Inspection Certificate described in Appendix 6 of the 17th Edition of the IET Wiring Regulations, together with any supportive documentation, to the Engineer within seven days of the test being carried out.

4.0 LABELLING

4.1 Identify each switchboard and all units mounted thereon and each distribution board and motor starter by an externally fitted approved label inscribed with the circuit reference shown on the schedules and drawings. For further details refer to Part 13.

4.4.1 Ensure safety signs are of the types defined and in conformity with the requirements of BS 5378.

4.2 Identify loose switchgear such as fused switches, switch fuses, distribution boards, isolators, indicating switches, starters and control switches controlling remote equipment by externally fitted approved label re engraving, indicating the equipment controlled.

4.3 Identify each junction box by an externally fitted approved label indicating the type of service contained, such as bells, radio and fire alarm.

4.4 In each type of distribution board place an approved circuit list which may be a card enclosed in a non flammable transparent plastic envelope securely fixed to the inside of the door. Ensure the list is typewritten, and shows the number of each way, its reference as indicated in the schedules and drawings, the rating of fuse link or miniature circuit breaker, the cable size and the apparatus connected. Arrange the list so that the circuit details can be modified at a later date. For guidance purposes refer to the format of the circuit list included in the particular specification.

4.4.1 Clearly identify the circuit ways either by the miniature circuit breaker or fuse bases and

carriers being indelibly numbered in an approved manner or by the label. This may be by means of a numbered plan or a printed statement to the effect that the numbering of the ways is from left to right.

4.4.2 Show on the circuits list which circuits have items of equipment that can be damaged by 500V insulation tests.

4.5 Where low voltage is present provide labels in accordance with the 17th Edition of the IET Wiring Regulations.

4.6 At every connection of a protective conductor to an earth electrode provide a label in accordance with the 17th Edition of the IET Wiring Regulations.

4.7 Provide a Notice inscribed with red letters on a white background recommending periodical inspection and testing in the main substation or switchroom, in accordance with the 17th Edition of the IET Wiring Regulations. At this position indicate the Installers name, address and telephone number, together with those of the Engineer. Indicate the frequency of periodic testing at this position.

4.8 In HV electric discharge lighting installations, provide labels in accordance with the 17th Edition of the IET Wiring Regulations.

4.9 Label all 'accessories' internally with their circuit reference.

4.10 Securely fix all labels by an approved means, except those on socket outlets which may be fixed from suitably engraved adhesive tape on the rear of the face plate.

4.11 Ensure engraved labels, where specified, are generally white/black laminated plastic, engraved to show a minimum of 6mm black lettering on a white background, except for multiphase switchgear which shall be labelled "DANGER - 415 VOLTS" (or applicable line to line voltage) in 20mm red lettering on a white background.

4.12 Fit all final circuit cable connections to outlets, fittings, etc, with an approved identification marker.

4.13 Ensure where it is necessary to fit labels to intrinsically safe circuit/components these on a blue background with white lettering.

5.0 RECORD DRAWINGS

5.1 The Engineers will supply a full set of prints of the proposed electrical installation. Keep these prints on site and make available for perusal by the Engineer at any time. As the works progress, ensure that all alterations are marked up on these drawings by a competent person to indicated:-

.1 All variations to positions, runs, sizes and types of equipment, trunkings, cable trays, cables, conductor joints and main cable routes above and below ground.

.2 Details of circuiting, distribution board arrangements and equipment labels.

.3 Schedule of luminaires

.4 Record of position of buried external services.

5.2 One month before practical completion submit draft copies of record drawings to the Engineer who will peruse them for comment.

5.3 Following comment by the Engineer produce record drawings which are legible and professionally produced, and comprise the following and are complete in all respects:-

.1 Clearly marked 'as fitted' or 'as installed'

.2 Fully drafted.

.3 Fully cross referenced

.4 Have a prominent border.

.5 Have complete title blocks. Ensure title blocks are of a consistent format throughout for all record drawings comprising a set.

.6 Ensure all layouts, sections, room plans etc. are up to date and all rooms are numbers where applicable.

5.4 Provide complete record drawings in sufficient time to be incorporated as part of the Operating and Maintenance Instructions and include:-

.1 One set on plastic film.

.2 Two complete sets of prints on heavy quality paper to be incorporated within each operation and maintenance manual produced.

5.5 Fold all drawings neatly as applicable and insert into individual A4 size plastic wallets for incorporation within the Operating and Maintenance Manuals under their relevant section.

6.0 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

6.1 One month (minimum) prior to the programmed completion date for the works, submit two Draft Operating and Maintenance Instruction Manuals to the Engineer who will peruse them for comment. It is recognised that some commissioning/testing data will not be available at that date.

6.2 Following comment by the Engineer prepare and hand over two complete sets of identical hard covered binder Operating and Maintenance Manuals, at or before the date of practical completion.

6.3 Ensure all information contained within these manuals is legible and professionally produced, and comprises the following information and is complete in all respects.

1 Full instructions from manufacturers on the operation and maintenance of equipment supplied under the contract.

2 Information on any special tools that may be required for service.

3 Description of emergency action to be taken in event of equipment failure, including a list of servicing agents, manufacturers names, addresses and telephone and fax numbers.

4 A schedule of ordering codes for all equipment installed, including manufacturers reference numbers and name plate data where applicable.

5 A full of set of record drawings, including schematics and diagrams for the complete installation, as listed under clause 5.0 of this specification part.

6 A list manufacturers recommended spares for each item.

7 Provide a 'master index' and include within the Operation and Maintenance Manuals.

Where the Operation and Maintenance Manuals consist of several volumes provide a complete master index within each of the volumes which form the overall set.

8 Provide a comprehensive and complete schedule of symbols for each relevant section of the manuals.

9 Only includes data associated with installed systems and in the case of manufacturer's literature, only includes originals of catalogues etc. Photocopies are not acceptable. Ensure manufacturers literature is of current issue at the date of handover.

10 Provide a consistent form of page numbering and maintain throughout.

11 Include full sets of test certificates/records, along with copies of any maintenance agreements.

6.4 Bind the manuals with a cover which clearly states the contract title and site identification. Make these covers consistent for all volumes of manuals forming part of a set.

6.5 Ensure all Operation and Maintenance Manuals along with relevant record drawings are A4 in format. If the record drawings are larger than A4 fold neatly and contain within individual A4 clear plastic wallets within the associated manual.

6.6 Allow and arrange for complete instruction and demonstration of all systems to the employers representatives in the use and correct operation of the complete installation and plant.

7.0 SPARES

7.1 Unless otherwise defined in the particular specification on completion of the Contract, hand over to the Clients representative the following spare items:-

7.7.1 Socket Outlets: One spare 3 amp BS 1362 fuse for every five 13 Amp plug tops supplied. One spare 13 amp BS 1362 fuse for every five 13 amp plug tops supplied.

7.7.2 Connection Units: As socket outlets.

7.7.3 Consumer Units: One spare fuse for each type and size for each unit.

7.7.4 Distribution Board: 30 amp and below - six cartridges for every type included.
Over 30 Amp - three of every type included

7.7.5 Refer to appropriate parts for quantities of spare plug tops and glasses for fire alarm contacts.

8.0 SHOCK TREATMENT CARD

8.1 Provide a copy of the Electrical Times shock treatment card at each main switch panel position. Ensure the card gives the following information.

8.1.1 Instructions for isolating a person from live conductors.

8.1.2 Artificial respiration and resuscitation methods.

8.1.3 Location of nearest telephone and telephone number of whom to contact for assistance.

9.0 RUBBER MAT(S)

9.1 Install rubber mats of 11kv tested pattern in accordance with BS 921 as necessary in each switch room.

9.9.1 Ensure the mat(s) are at least 600mm wide and the length not less than that of each switchboard and laid on the floors in front of all switchboards.

10.0 SPECIALIST TOOLS

10.1 Ensure that any tools which are required of a special nature for any equipment, etc, installed, are handed to Engineer at the Handover Meeting in a purpose designed box or receptacle.

PART 15 - EMERGENCY LIGHTING INSTALLATION

Clause	Descriptions
1.0	GENERAL REQUIREMENTS
2.0	WIRING MEDIUMS
3.0	TYPES OF SYSTEM(S)
4.0	INSTALLATION REQUIREMENTS
5.0	TESTING AND COMMISSIONING

PART 15 - EMERGENCY LIGHTING INSTALLATION

1.0 GENERAL REQUIREMENTS

1.1 This specification contains those standard technical clauses applicable to emergency lighting installations. The exact scope of work including technical design parameters, is as detailed in the particular specification and the respective electrical services drawings.

1.2 Where applicable ensure the emergency lighting installation complies fully with the requirements of the following British Standard Guidelines and Recommendations.

1.2 BS 2560 : Specification for EXIT signs (internally illuminated).

1.2.2 BS 5266 : Part 1 CP for emergency lighting of premises other than cinemas and certain other specified premises used for entertained.

1.2.3 BS 5266 :Part 3 specification for small power relays (electromagnetic) for emergency lighting application up to and including 32A.

1.2.4 BS 5378 : Safety signs and colours

1.2.5 BS 5499 :Fire safety signs, notices and graphic symbols.

1.2.6 BS 5655 :Part 1 Safety rules for construction and installations of electric lifts.

1.2.7 BS 6133 :Safe operation of lead acid stationary cells and batteries.

1.2.8 BS 6290 :Lead acid stationary cells and batteries.

1.2.9 ICEL 1001 :The construction and performance of battery operated emergency lighting equipment.

Part 1 Central system equipment

Part 2 self contained luminaires and associated systems.

1.2.10 ICEL 1002 : The photometry of battery operated emergency lighting luminaires.

1.2.11 ICEL 1003 : Emergency lighting - applications guide.

1.2.12 ICEL 1004 : Modifications of mains luminaires to incorporate an emergency lighting conversion kit.

1.2.13 The 17th Edition of the IET Wiring Regulations.

1.2.14 HMSO - Recommendations on Safety in Cinemas.

1.2.15 HMSO - The Hospital Technical Memorandum No.11 and 16.

1.2.16 Local Authority standing orders and byelaws.

1.3 On completion at the works fully commission the entire installation in the presence of the Engineers.

1.4 Ensure the system(s) defined operate(s) on non-maintained or maintained principles as detailed later in this specification. Complete with all appropriate relays, battery chargers, batteries connection outlets etc.

2.0 WIRING MEDIUMS

2.1 Use the wiring mediums as defined in the appropriate part of the particular specification and identify and segregate from other circuits as defined in Part 1, of this Section of the specification.

2.2 Note that where no specific wiring medium is specified then this is of the appropriate type as defined in BS 5366 in Part 1, Clause 9.0 of this specification. Where 'central' battery systems are to be installed make the cable sizes a minimum of 2.5mm². Refer to the particular specification for details.

2.3 In cases where luminaires are connected to a central battery system(s) then colour code the conductors for ease of identification and fully segregate from other services.

2.4 Install non-maintained emergency luminaire with a 'mains' unswitched live connection fed from the appropriate circuit of the designated distribution board.

3.0 TYPES OF SYSTEM(S)

3.1 Use the types of system(s) as defined in the particular specification and adopt the following minimum appropriate requirements:-

3.1.1 Complete self-contained luminaires with lamps, legend (where required for exit signs) alkaline batteries (suitable for temperatures up to 50C) of a 3 hour duration period, charger a red light emitting diode (mains healthy) and mains sensing devices. Brief description of operation for various types are as follows:-

.1 Non-maintained - emergency light 'OFF' and battery on automatic charger when 'mains' supply is healthy. The luminaires lamp shall automatically switch 'ON' when 'mains' is interrupted and powered by battery.

.2 Maintained - emergency light 'ON' and battery on automatic charge when 'mains' supply is healthy. The same luminaire lamp remains 'ON' powered by the battery when the 'mains' supply is interrupted.

.3 Sustained - normal mains' powered lamp 'ON' and battery on automatic charge when 'mains' is healthy. Separate emergency lamp is automatically switched 'On' when 'mains' supply is interrupted.

3.1.2 Complete embodiment control gear for fluorescent luminaires with charger/inverter module (of appropriate rating) battery pack and wire to suit maintained or non-maintained emergency use as the case may be. Use the batteries of the high temperature type minimum 50 C capable of a 3 hour operation period.

3.1.2.1 Fit/wire the above components within the selected luminaires by the luminaire manufacturers taking care to keep components away from hot components. Install a charger indication of the red light emitting diode type within each luminaire.

3.1.2.2 Ensure the operation of the components is as defined in the particular specification.

3.1.3 Ensure central battery system(s) are of the battery cubicle type, of the rating defined in the particular specification and allow the complete connected emergency system to operate for at least three house in the event of 'mains' failure.

3.1.3.1 Ensure each battery cubicle contains the following minimum equipment: -

.1 A suitably rated battery charger of the solid state constant voltage type, with self protecting current limiting, for protection against low battery voltage and short circuit protection.

.2 A suitably rated load contactor arranged to changeover to battery operation in the event of mains failure.

.3 A transformer rectifier circuit with dc smoother.

.4 Suitably rated 'mains' and 'control' fuses.

.5 Phase failure relay, connected to the incoming SP and TPN supply of the designated source(s) to be monitored.

.6 Alarm indicators mounted on the front of the panel for the following: high and low voltage, charger failure alarm. Provide a common volt free contact to operate when any of the alarms are initiated for remote fault indication.

.7 Include a voltmeter with 'load' and 'charge' ammeters.

.8 Where designated, install complete a double pole fused distribution board with 20% spare ways to serve local emergency lighting distribution boards.

.9 Provide isolating switches on the cubicles to enable the maintained lighting supplies to be isolated when required.

.10 Panel internal wiring.

.11 Ensure that for maintained systems the cubicle encloses double wound transformer (with earth screen) wired to normally open contacts of the contactor controlled by its own switch.

3.1.3.2 Unless otherwise specified in the particular specification, install alkaline pattern batteries with plastic cases and having a standby life of 25 years. The voltage size is as defined in the particular specification. Ensure the recharging of the system after use is completed within 24 hours.

3.1.3.3 Where local emergency lighting distribution boards are to be used ensure these are of the appropriate patterns compatible with the system source, voltage etc. and are fitted complete with local isolator/contactor remote control relays for remote monitoring as declared, the particular specification. All such boards shall have double pole fused outgoing ways.

3.1.3.4 Ensure 'slave' type luminaires are of the types defined in the particular specification and are supplied and installed complete in every respect, and of the appropriate types to suit the maintained or non-maintained connections and voltage sizes of the selected system(s).

4.0 INSTALLATION REQUIREMENTS

4.1 Connect each battery cubicle to the mains source designated and controlled by a suitable multipole isolator mounted adjacent the respective cubicle. Enclose final connections in flexible conduit.

4.2 Ensure final connections to emergency luminaires are as follows:-

.1 Self contained luminaires are fitted via concealed plug in ceiling rose or in the case of wall mounted units, fuse connection units. Final connections are with multicore butyl flexible cables of the appropriate size.

.2 Embodiment control gear are via 4 pin ceiling rose outlet of different pattern to conventional 3 pin ceiling roses, mounted adjacent to 'mains' connection arrangement controlling 'mains' supplies to luminaires. Final connection is with multicore butyl flexible cable of the appropriate size. Fit appropriate warning labels externally to luminaires stating emergency source connection. Pin configuration for 4 pin ceiling roses are as follows: -

i) Pin 1 - switched live

ii) Pin 2 - Neutral

iii) Pin 3 - Earth (separate CPC)

iv) Pin 4 - Unswitched live

.3 Connect 'slave' luminaires for central systems in the manner defined under 4.2.1 but using the 4 pin rose defined under 4.2.2 above.

4.3 Where test switches are required in the particular specification to operate the emergency luminaires fit the same type/pattern as normal lighting switches but of key action. Wherever possible mount the key switches on the respective multigang plate of the 'local' lighting control switches.

5.0 TESTING AND COMMISSIONING

5.1 On completion of the total emergency lighting installation(s) carry out in the presence of the Engineer and Fire Officer, the complete testing and commissioning of the whole installation in accordance with the equipment manufacturers recommendations and the requirements of BS 5266.

5.2 Upon satisfactory completion of the above tests the equipment manufacturers will be required to supply the necessary completion certificate for the complete system as outlined in BS 5266.

5.3 Allow in the costs for completing all required commissioning and system demonstration tests. Give a minimum of 10 days notice of the proposed test dates to enable the Engineers/Fire Officers to witness these tests.

5.4 Note that a full system load test is required which comprises the operation of all emergency luminaires for the required battery support periods of 3 hours followed by full recharging within 24 hours.

5.5 Fully record all tests and issue with the "As Fitted" drawings and the operating and maintenance manuals.

5.6 Detail all positions, number and types of installed emergency luminaires on the 'As Fitted' drawings and in the operating and maintenance manuals.

PART 16 - FIRE ALARM INSTALLATIONS

Clause	Description
1.0	GENERAL
2.0	SYSTEM TYPES AND OPERATION
3.0	COMPONENTS
4.0	INSTALLATION WIRING MEDIUMS
5.0	TESTING AND COMMISSIONING

PART 16 - FIRE ALARM INSTALLATIONS

1.0 GENERAL

1.1 This specification contains those standard technical clauses applicable to the fire alarm installation. The exact scope of work including technical design parameters, schedule of zones and list of drawings are as detailed in the particular specification.

1.2 Where applicable ensure the fire alarm installations also comply fully with the requirements of the following British Standards, Guidelines and Recommendations.

1.2.1 B.S. 5306 : Fire extinguishing installations and equipment on premises.

1.2.2 B.S. 5445 : Components of automatic fire detection systems.

1.2.3 B.S. 5446: Specification for components of automatic fire alarm systems for residential premises.

1.2.4 B.S. 5588: Fire precautions in the design and construction of buildings.

1.2.5 B.S. 5839: Fire detection and alarm systems in buildings. Part 1 Code of practice for installation of servicing.

1.2.6 B.S. 5839: Part 2 Specification for manual call points.

Part 3 Detector/release.

Part 4 Control/indication.

Part 5 Optical beam.

1.2.7 B.S. 6133: Code of practice for safe operation of lead-acid stationary cells and batteries.

1.2.8 B.S. 6266: Code of practice for fire protection for electronic data processing installations.

1.2.9 B.S. 6290: Lead-acid stationary cells and batteries.

1.2.10 Fire Offices Committee (FOC) - rules for automatic fire alarm installations for protection of property.

1.2.11 Local Authority standing orders and byelaws.

1.2.12 The 17th Edition of the IET Wiring Regulations.

1.2.13 HMSO - The Hospital Technical Memoranda Nos. 16, 81, 82, 83, 87, 88.

1.3 Note that the schematic diagram(s) produced for tendering purposes is/are not to be used for construction works as these drawings only denote the zonal / operational requirements. Obtain both during the tender period and prior to construction work fully detailed wiring diagrams from the selected manufacturer. These drawings must

define all cabling requirements. Submit copies of manufacturer's drawings to the Engineers for comment prior to the commencement of the works.

2.0 SYSTEM TYPES AND OPERATION

2.1 Generally, unless otherwise specified in the particular specification the fire alarm system comprises the following:-

.1 Annunciator / control panel(s).

.2 ELV battery cells/charger.

.3 'Mains' power supply.

.4 Manually operated 'break glass' call points.

.5 Automatic smoke (optical/ionisation) and heat (fixed temperature/rate of rise) detectors.

.6 Magnetic door release units together with control relays/push-buttons.

.7 Sprinkler zone pressure sensors.

.8 Call points operated in conjunction with fusible links (plant rooms).

2.2 Ensure the fire detection and alarm systems derive their power supply from a control unit which incorporates a standby battery and automatic charger designed so as not to become inoperative in the event of failure of the standby battery or the a.c. supply.

2.3 Ensure the fire alarm system is actuated by the operation of either a manual 'break glass' call point or automatically by smoke detectors, heat detectors and, where applicable, the sprinkler system pressure switches and/or fusible links.2.3.1 On the instigation of the above, ensure this operates the respective fire alarm zone indicator of the annunciator / control panel(s), the sounder alarm circuits, isolate defined plant systems, demagnetise signal(s to remote indicator panel(s) and/or fire brigade network alarm system.

2.4 Unless otherwise specified in the standard specification, ensure the fire alarm system is 24V d.c. 'Open circuit' principle with all wiring being continuously monitored such that in any event of the following conditions, it shall cause a "fault" indication to be displayed at the main annunciator panel:

.1 Short circuit fault.

.2 Open circuit fault.

.3 Earth fault.

2.4.1 Arrange the control circuitry so that none of the above conditions cause the fire alarm sounder to operate. Ensure that monitoring of the system is intrinsic in the control

circuit design, automatic in operation and does not require the manual operation of switches or other apparatus.

3.0 COMPONENTS

3.1 The various components listed below illustrate the minimum arrangement/types required and where necessary adapt these to suit the specific details outlined in the particular specification furthermore, ensure the components are of the flush or surface patterns suitable for the installation requirements defined and are supplied complete with all necessary boxes, seals/gasket, cable entries, fixings, covers etc.

3.1.1 Ensure annunciator / Control Panels are of modular design complying with B.S. 3116 : Part 4 and have:-

.1 Suitable steel enclosure (finish to be defined).

.2 Required quantity of fire zone circuit indicators (with lamp test facilities).

.3 Zone fault indication to suit quantity of zone circuits (with lamp test facilities).

.4 'Power' supply failure indication.

.5 'Battery healthy' indication.

.6 Zone lamp test key switch (enable).

.7 'Alarm mute' key switch (enable).

.8 'All sounder' test key switch (enable).

.9 Two-stage alarm facilities (where applicable i.e. pulsating - alert and continuous - evacuate). Also 'master alarm' control key switch.

.10 Zone identification.

.11 All necessary operating relay/switch devices, auxiliary relays - controlling remote plant item, door release units etc.

.12 Sufficient quantity of terminals to receive all incoming and outgoing circuit wiring.

.13 Facilities for supervisory buzzer (where applicable).

.14 Battery cells/charger unit of a size suitable for the full system. In large installations mount the above items in separate steel enclosure of similar suite to the panels.

.15 Facilities for remote signalling to local fire brigade or alarm centre network.

3.1.2 Sounders - install the type specified the particular specification - red finished and, in turn, connected to the respective annunciator panel(s) using 'A; and 'B' dual circuit wiring techniques.

3.1.3 Break glass call points - install of red finish and comply with B.S. 5839: Part 2, complete with scored glass, suitable inscription of operations, integral LED indicator, key-operated test facilities and appropriate enclosures for flush or surface mounting.

3.1.4 Smoke detectors - install of the 'ionisation' or 'optical' patterns as shown on the drawings and complete with interchangeable plug-in bases, integral LED indicator (unless remote indication is specified) and appropriate mounting conduit boxes.

3.1.5 Heat detectors - install of the fixed temperature patterns in accordance with B.S. 5445 with or without rate of rise as defined in the particular specification. Install each complete with interchangeable plug-in bases, integral LED indicator (unless remote indication is specified) and appropriate mounting conduit boxes.

3.1.6 Remote indicators - install of white square mounting plates complete with appropriate mounting boxes (flush or surface-mounted). Fit appropriate designation labels on plates giving zone code reference.

3.1.7 Install door release units of a type similar to Briton 999 and of the electromagnetic type, each complete with electromagnetic unit, the iron armature unit (fitted to the door), the 'mains' relay/power unit, a local fuse connection unit provided mains supply for the relay unit and a push- button to release the door. Install each of the above units complete with appropriate box enclosure.

3.1.8 Sprinkler pressure sensors - will be supplied and installed by others but connect to the auxiliary section of the annunciation/control panel(s).

3.1.9 Fusible link units - as above but connect to panel(s) via wall-mounted electromechanical push-button call points.

3.1.10 End of line units - install on all monitored circuits and generally connect at the end of the respective circuit contained within purpose made boxes or where designated by the manufacturers within the panel(s). Where remote mounted, fit appropriate labels to cover for ease of identification.

3.1.11 Duct-mounted smoke sensors - where smoke sensors are to be mounted in mechanical ductwork supply complete with the necessary sample and exhaust probes (of appropriate length to suit size of duct) mounting boxes fitted with transparent covers and appropriate designation labels. Note: unless otherwise specified use only 'optical' sensors for these purposes.

3.1.12 Power supply units - install an a.c. supply operated automatic constant voltage charger, ammeters and voltmeter (fitted to the cover of the enclosures), a pre-charged standby sealed lead or alkaline 'battery' an appropriate metal enclosure, output fuses and mains 'On' indication.

3.1.12.1 Ensure the 'standby supply' capacity for each installation is such as to allow the system alarm sounders and auxiliary loads to operate continuously for a minimum of 30

minutes and be fully recharged within the following 24 hours. Furthermore, ensure the 'standby supply' system is of sufficient capacity to support the fire alarm system in standby mode for a minimum period of 24 hours prior to any initiation of an alarm condition. In addition to the above, ensure the battery charger unit is capable of supporting the entire system alarm load in the absence of the 'battery'.

3.1.12.2 Ensure fault monitoring and alarm indication is provided for:-

.1 Mains power failure.

.2 Battery power failure.

.3 Charger output failure.

3.1.12.3 Contain power supply units in a ventilated sheet steel enclosure designed to ensure adequate heat dissipation. Treat all steel so as to be acid/alkaline corrosion resistant. Ensure the enclosure is gloss paint finish.

4.0 INSTALLATION/WIRING MEDIUMS

4.1 Refer to the particular specification for details of wiring sizes and types. Where no details are given then use the cable type multicore MICCV cable with red LSF serving with 1.5mm² minimum size conductor for 'actuation' circuits and 2.5mm² minimum for 'sounder' circuits using 'A' and 'B' wiring technique.

4.2 Install fire alarm wiring installations to suit other installations i.e. surface to flush as the case may be. Refer to the particular specification for exact details.

4.3 Where 'heat' or 'smoke' detectors are installed in locations which cannot be readily seen such as ceiling/floor voids etc., then fix in the locations indicated on the drawings, remote LED indicator units and connect to the respective detector back plate terminals and install flush or surface to ceiling or walls boxes as the case may be.

4.4 In instances where automatic signalling facilities are required to remote situations such as the local fire brigade, remote indicator panels etc. (using British Telecom landlines or similar) under the contract, supply and fix (albeit by the specialist manufacturer) the necessary interface/indication units required for transmitting and receiving alarm signals. Ensure these components are compatible the existing system(s) or private network equipment. Ensure all associated installation costs, charges etc., are included in the tender.

4.5 Include all auxiliary control wiring under the contract namely to field items. systems such as door release units, shutdown/actuation of mechanical plant systems, sprinkler system pressure sensors, extinguishing systems, (such as Inergen or Co^2), fusible link systems etc. In addition, ensure that the necessary relay and termination facilities are included within the respective annunciator / control panel(s) to receive/control the above.

4.6 Unless otherwise specified, include for the specialist manufacturer of the equipment to finally connect only the incoming and outgoing circuit wiring of the annunciator / control panel(s).

4.7 Ensure each fire alarm system has a dedicated mains supply from the 'LV' source terminating in the annunciator / control panel(s) respective power supply and via a wall-mounted isolating switch. Control the 'LV' source supply by a suitably rated lockable switch fuse/MCB. Paint this switch together with the respective terminating isolating red and label "FIRE ALARM - DO NOT SWITCH OFF".

5.0 TESTING AND COMMISSIONING

5.1 On completion of the installation works with the selected manufacturer, carry out the complete testing, commissioning and demonstrating of the system operation as detailed below:-

5.2 Tests to be Conducted

5.2.1 A visual inspection of the whole of the installation, covering equipment and section in subways, walkways, crawlways, ceiling and floor voids where accessible.

5.2.2 The operation of all panels, accessories and items of equipment and a check for proper function, including such items as may have been supplied by others but wired under this Contract. Make these tests under normal operating conditions, including the discharge and recharging of the 'battery' system, and the results noted.

5.2.3 Make insulation tests covering all circuits and between phases, phase to neutral, phase to earth and neutral to earth. Where a central or main distribution point is 10 megohms or above, individual sub-circuit tests may be omitted at the discretion of the Engineer.

5.2.4 Functional test of all smoke detectors by use of an approved smoke generator-testing device.

5.2.5 Functional test of all "fixed temperature" or "rate of rise" heat detectors, by an approved heat source testing device.

5.2.6 Simulated tests for fire or fault alarm at one or more detector or manual contact as may be instructed by the engineer, with all such tests being agreed and recorded onto a system check list which will be approved by the engineer prior to any witness testing being carried out.

5.2.7 for correct polarity of the alarm devices, bells, sirens, klaxons etc., and all other items where correctness of polarity is essential.

5.2.8 Testing of all sprinkler sensors and fusible link units.

5.2.9 Testing all visual indicators under simulated operational conditions with sounders out of circuit.

5.2.10 Testing of auxiliary signals to remote panels via British Telecom landlines.

5.3 Procedure

5.3.1 Carry out, together with the manufacturer the full tests listed above to your and their own satisfaction. Thereafter, fully demonstrate the complete operation of the system to the satisfaction of the Engineers and Fire Officers.

5.3.2 Arrange a mutually agreed programme for the above demonstrations with the Engineers.

5.4 Documentation

5.4.1 The manufacturer shall be required to issue the required fire alarm system test certificate(s) (as detailed in B.S. 5839).

5.4.2 Record all the audibility test results and present them in tabulated form.

5.4.3 Issue copies of all documentation including the above to the Engineers for comment prior to inclusion in the final handover documentation.

5.5 Audibility Tests

5.5.1 Fully test the fire alarm system's audible alarm facility to ensure that the correct audibility levels are achieved as required by B.S. 5839. conduct these tests in the presence of the Engineers, Fire Officer and Employer's representative.

5.5.2 Carry out the test on completion of the installation when all mechanical plant is fully functioning to ensure that realistic results are obtained.

5.5.3 Ensure that the manufacturer measures and records the sound pressure level in each room, area or plant space. Make a number of tests and record in each area to obtain an average value.

5.5.4 Immediately inform the Engineers in writing, if in any area the required audibility level is not achieved.

5.6 Fire Alarm System instruction

5.6.1 Note that within the tender allow for the equipment manufacturers to provide one full days' instruction of the complete system for the Employer's representative after the contract completion date unless detailed otherwise in the particular specification.

5.6.2 The above instruction course shall include a practical demonstration of the installation and equipment. Be responsible for arranging the required demonstration and agreeing the time and dates with regard to the overall contract programme works.

5.6.3 Ensure that the 'As Fitted' drawings and manuals are available before the Employer's demonstration and instructions.

5.6.4 At practical completion hand over any spare detection bases to the Employ's representatives and obtain a written receipt which is submitted to the Engineers.

5.6.5 Provide 10% spare glass and test keys for the alarm break glass units installed. Hand these to the Employer's representatives at practical completion and obtain a written receipt, which is issued to the Engineers.

5.7 Spare Components

5.7.1 Provide the under noted items as 'SPARES', to be handed over to the Client or his representative at completion of the Contract. All items shall be new, unused and contained within the manufacturer's standard packaging and suitably labelled as to type and use. Provide typewritten schedules detailing the quantities supplied of each item. Hand over all spares in one consignment and obtain a signature for receipt of the goods. The quantities of spares provided are 10% (ten per cent) with a minimum of 3 (three) of any one type and or rating. The 'spares' shall comprise:-

.1 Indicator lamps or LED's.

.2 'End of line' resistors or diodes.

.3 Printed circuit cards (where these are of the plug-in type).

.4 Smoke detectors (each type as installed).

.5 Heat detectors (each type as installed).

.6 Glasses for break glass units (minimum quantity 10).

.7 Sounders (each type as installed).

.8 Special keys for testing or operating equipment.

.9 Fuses or other safety devices contained within the fire alarm panel(s).

.10 All similar necessary spares associated with any gas extinguishing system installed.

Section 3

Particular Electrical Specification

Section 3

Particular Electrical Specification

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1. INTRODUCTION

1.1 General

The Electrical Contractor (EleC) shall be responsible for the design, supply, installation, commissioning and setting to work of the complete electrical installation for this development. The development comprises:

- 20 no. apartments
- Communal Area's to include Stairwells, Corridors, Bin Store, Cycle Store and Plant Space;
- 2 No Ground Floor Retail Unit (Shell Only);

The EleC shall comply with all aspects of this document, which shall be read in conjunction with the Standard Electrical Specification.

The EleC shall be responsible for the full design of the complete electrical installation. This shall also involve the production and distribution (to all relevant parties), of electrical design and builder's works drawings and information required by other members of the project team and other interested parties. The EleC shall also provide to all interested parties, all requested information, prior to, during and after the construction phase and in due time.

The EleC shall liaise with the Employers project team for the project, which shall include the Employer Agent (EA), Architect, Structural Engineer, Quantity Surveyor and Consultant Engineer (Watt Energy & Consulting Engineers Ltd), during the design and construction phases, to ensure that the design is suitable and acceptable to the Employer and the project team and fit for purpose.

All electrical drawings shall be produced in AutoCAD 2014 format. At project completion "as fitted" drawings shall be issued for inclusion in the Health & Safety File, together with all relevant manufacturers literature and manuals. A further copy of the "as fitted" drawings and specifications shall be issued by the EleC to the Employer, for his records. This shall be issued on CDROM.

If the EleC has reason to believe that anything described in this Specification, or shown on the indicative tender drawings is inconsistent, or if the EleC has reason to believe that there are inconsistencies in respect of any specified item and its performance, he shall at the time of tender bring this to the attention of the Main Contractor, EA and the Engineer, who will notify all tenderers of the decision. Thereafter, the EleC shall not be entitled to any alteration in tender price, or the waving of any guarantee in respect of materials or workmanship.

The EleC shall at all times co-ordinate his works with those of all other Sub-Contractors, claims in respect of lack of such co-ordination will not be admissible.

The EleC shall satisfy himself as to the correctness of all connections between equipment supplied under this contract and equipment supplied under any other contract before any of the former is put into operation. Reasonable notice shall be given by the EleC to the Contract Administrator before any such connection is made.

The EleC is responsible for the storage and security of all items being supplied by him, whilst on site. The Employer will not be responsible for any payments associated with the damage or loss of equipment from site, unless fixed to the building structure. The EleC shall be responsible for ensuring all plant and materials are adequately insured for the duration of the contract.

It is critical the EleC complies fully with the requirements of the Main Contractor in relation to overall co-ordination and programme matters.

If the EleC fails to comply with the Main Contractors programme/co-ordination, then any costs associated due to delays, abortive works, additional works, etc, will be off set against the EleC's contract sum.

1.2 Responsibilities During Defects Liability Period

The defects liability period for the Electrical Services associated with the project shall be in accordance with the Employers requirements documents.

If the EleC fails to attend within the detailed time scales, then an alternative contractor will be engaged with all associated costs being deducted from the EleC's retention monies or invoiced direct to the Main Contractor or EleC at the sole discretion of the Employer.

1.3 General Scope of Electrical Works

This Specification of Electrical Requirements generally relates to the design, supply, installation and commissioning of all new electrical services and associated controls required for the proposed development.

The work shall comprise the whole of the labour and unless otherwise indicated, all materials necessary to form a complete installation, and such tests, adjustments and commissioning as are prescribed in subsequent clauses and as may otherwise be required to give a complete working installation to the satisfaction of the Engineer.

The words "complete working installation" shall mean not only the major items of plant and equipment conveyed by this specification but all the incidental sundry components necessary for the complete installation of the works including all labour charges.

Works shall include, but not be restricted to, the design, supply, installation, commissioning and setting to work of the following:

- The design, supply and installation of the incoming cables from the MOD16 unit in the plantroom to the main BNO panel in the plantroom.
- The design, supply and installation of the mains distribution system for all apartments and communal areas including the provision of all sub meters. The electric meters shall be located within the apartments adjacent to the consumer units.
- The design, supply and installation of the low voltage sub mains distribution system. This shall include the supply of all 80A switched fused isolators and associated tails/trunking etc (one per property), from the distribution board on each floor and the installation of all sub mains distribution cabling throughout the buildings (on cable tray), to each apartment dual RCD consumer unit. This shall include the BNO distribution as indicated on the tender schematics.

- The design, supply and installation of all landlords distribution boards to serve the communal areas.
- The design, supply and installation of the complete small power systems within all properties, plant areas and communal areas.
- The design, supply and installation of the complete lighting requirements to all properties, plant areas and communal areas.
- The design, supply and installation of cable tray and associated materials throughout the proposed service risers and corridor ceiling voids.
- The design, supply and installation of all switching systems.
- The design, supply and installation of the emergency lighting systems within the communal areas.
- The design, supply and installation of fire alarm and detection systems within all properties and communal areas.
- The supply and installation of electric panel heaters to communal areas and electric towel rails within the apartments and all associated power supplies.
- The design, supply and installation of the Simply IP equipment and cabling to all apartments.
- The wiring and setting to work of all ventilation fans & controllers.
- The Wiring of supplies for all mechanical plant.
- The design, supply and installation of PV panels to the roof.
- The design, supply and installation of an access control system and CCTV Installation.
- The design, supply, installation and setting to work of a video door entry and access system to all properties and main entrance doors.
- The design, supply and installation of a television and satelite installation to serve all properties, complete with all associated infrastructure throughout the building.
- The design, supply, installation and wiring of the telephone system from the main incoming BT positions to each agreed position(s) within each property. This includes all final connections at all junction boxes with the only exception being the final actual connection of the mains incoming line at the incoming BT position(s). All telephone cables must be tested prior to second fix.
- The inspection, testing, commissioning and certification, of all the various elements of the electrical installation.
- The supply of all operating and maintenance instructions and manufacturer's literature.
- The supply and distribution of all design, construction and as-fitted drawings.

The EleC shall be responsible to carry out their own chasings and builders work for all apertures with a dimension of less than 50mm. This shall cover all cable tray, XLPE/SWA cables, etc. throughout the properties. All other builders work over and above the 50mm, shall be the responsibility of the Main Contractor. However the EleC shall be responsible for identifying, in good time, all holes, protrusions, chasings, etc required for the passage of pipes, cables, etc.

Any and all such builders work shall be identified to the Main Contractor at the earliest possible time and positions agreed. The EleC shall also identify areas where additional reinforcement may be required, particularly with regard to roof and floor structures prior to installation of equipment.

All Works conducted under this contract shall be in full compliance with all current Statutory Regulations, Health & Safety at Works Act, British Standards, IET 17th Edition Regulations and NICEIC Standards.

The IET Regulations, 17th Edition Standards shall be deemed the Industry Standard for the purpose of these works. Where there is doubt, the EleC shall consult with the Engineer in the first instance.

The EleC shall be responsible for the design, supply, installation, commissioning and setting to work of the complete electrical installation for the whole of the building. There are certain exceptions which are set out within this document, therefore it is imperative that this document is read in its entirety to

ensure all items required of the EleC are met and included within the tender costs. The Employer will take no liability for the cost of items not included.

1.4 Insurance Liability Cover

The level of Professional Indemnity, public and employers Liability Insurance required from the EleC shall be as prescribed within the employers requirements documents.

1.5 Construction Stage Responsibilities

The EleC's responsibilities during the construction phase of the project shall include, but not be limited to, the following:

- The provision of a non working site supervisor is a specify requirement of the client and must be covered within this specification and adhered too.
- Liaison with the Employer team.
- Liaison/co-ordination with other contractors.
- Liaison/co-ordination with services suppliers.
- Liaison with Employer appointed Building Control or local Building Control Officer
- Liaison with local Fire Officer
- Amendment and issue of drawings as and when required.
- Production and issue of electrical installation and commissioning programme at project start.
- Attendance at pre-project and all regular site meetings.
- Correction of defects reported at snagging.

At all times, the EleC shall liaise with other contractors on site to ensure all mechanical and electrical services can be installed in an efficient matter. For example, where services are run above corridor ceilings and within service risers, all trades shall be responsible for co-ordinating and considering both theirs and other trades. Adequate provision should be made so as not to impinge the economical installation of other services. The Main Contractor shall reserve the right to contra-charge contractors who have clearly failed to co-ordinate the works.

The EleC shall be responsible for the issue of a contract programme. The programme shall detail all works in sequence with the main contractors construction programme.

1.6 Post-Project Responsibilities

- Attendance at post contract review meeting (2 weeks from handover).
- Attendance for breakdowns or faults during the defects liability period.
- Attendance for regular maintenance covered within this specification.
- Attendance at 12 months defects meeting.
- Attendance at 24 months defects meeting.

1.7 Attendances & M&E Co-ordination Meetings

The EleC shall be responsible for all costs associated with attendance at all project team meetings, co-ordination meetings, pre contract meetings, regular site meetings (fortnightly then weekly for the last eight weeks), monthly M&E Coordination meetings and all other meetings organised by the project team.

At the monthly M&E meeting the EleC must table marked up copies of all as built drawings to date for open discussion. A separate set of drawings shall be provided for the consultants records.

In addition, at each M&E meeting the EleC must handover to the client, all plant instructions and guidance documents for all plant installed during that period.

1.8 Part L Compliancy

The EleC shall ensure compliance with Part L Building Regulations.

1.9 Maintenance Manuals, Operating Instructions and Building Manual

The EleC is to include for preparing operating and maintenance instructions and all other information required for the Health and Safety File in respect of the installations for which he is responsible. These shall be provided in a timely manner and shall include the "as fitted" drawings incorporating all deviations from the construction issue drawings. This information will be included within 'The Building Manual'.

All maintenance and operating manuals shall be copied to a CD along with all record drawings.

This information must include:

- A full description of each of the systems installed, written to ensure that the Employers staff fully understand the scope and facilities provided.
- A description of the mode of operation of all systems.
- Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc.
- A photo-reduction of all record drawings to A3 size together with an index.
- Legend for all colour-coded services.
- Schedules (system by system) of plant, equipment, valves, etc., stating their locations, duties and performance figures. Each item must have a unique number cross-referenced to the record and diagrammatic drawings and schedules.
- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers.
- Manufacturers technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.
- A copy of all Test Certificates (including but not limited to electrical circuit tests, corrosion tests, type tests, works tests, start and commissioning tests) for the installations and plant, equipment, valves, etc. used in the installations.
- A copy of all manufacturers guarantees, warranties and maintenance agreements offered by the electrical contractors and manufacturers.
- Starting up, operating and shutting down instructions for all equipment and systems installed.
- Control sequences for all systems installed.
- Schedules of all fixed and variable equipment settings established during commissioning.
- Procedures for seasonal changeovers.
- Recommendations as to the preventative maintenance frequency and procedures to be adopted to ensure the most efficient operation of the systems.
- Lubrication schedules of all lubricated items.
- A list of normal consumable items.
- A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date.
- Procedures for fault finding.
- Emergency procedures, including telephone numbers for emergency services.

The above information will be required in both electronic format and paper format. The EleC is to liaise with the client to ensure that all information is supplied in the same format as that used for the rest of the Building Manual.

The paper copy of the above information must be available for handing over to the Employer at the time of handover. Practical Completion Certificates will not be issued prior to the production of these manuals and certificates.

The EleC will be held responsible for the safe-running and maintenance of the installation until the requirements of this section have been satisfactorily completed.

1.10 Tenants' Instruction/Handbooks

Notwithstanding any information the EleC is called upon to provide within the previous section, the EleC is to prepare a set of operating instructions for each dwelling. These instructions should be suitable for inclusion in a tenant's manual, and shall give adequate instructions and explanations for the tenant to understand the operation of all plant and equipment within his/her dwelling. The instructions should be provided in a format that can be expected to be understood by the tenant.

The tenants' instructions for each dwelling are to be available prior to the period of Client instruction, and handed to the Employer at the time of handover. The EleC will include for the cost of training the clients' representatives in the use of the hand book, so that he can instruct the new tenants.

All costs as incurred under this section are to be priced in the tender as allowed for.

1.11 Temporary Electrical Supplies

All temporary supplies shall be the responsibility of the main contractor.

1.12 Builder's Work

The EleC shall allow within his tender for the provision of all necessary information with respect to builder work requirements, including checking the positions of preformed holes etc., marking out on site for hole positions, and the like and drilling holes as required to suit their installation.

1.13 On Site Record Drawings

The EleC is to keep on site a set of prints of all the installation drawings bound together, and he is to mark on these prints all variations from the drawings which are made to the works whether or not such variations are the subject of official variation orders, or whether they are due to the natural process of setting out the works.

The EleC shall also mark on the prints the information stated hereunder so that the prints form a complete and accurate record of the works as installed.

- The exact position of all buried or concealed services giving the dimensions from exposed and easily observed parts of the building or site.

The drawings must be marked as described above at intervals not exceeding three days and must be kept up to date for regular inspection by the client's agent. They are to be kept in a good and clean condition and are to be handed over to the client's agent at such times as he shall require them.

1.14 'As Installed' Record Prints

Throughout the execution of the Sub-contract works, the Elec shall keep on the site a complete set of up-to-date prints and schedules marked with "As Installed" details. These prints must be available at any time to the Supervising Officer or his representative.

These drawings can be hand annotated.

These on site record drawings will be used by the EleC to prepare "As Fitted" drawings for the Client. If, in the event, upon completion of the works, it being discovered that, the electrical contractor has failed to comply with this requirement and it becomes necessary for the Supervising Officer to examine or trace through installed services in order to update the "As Installed" drawings, the cost of this work will be time charged and debited to the retention monies being held on the Contract.

"AS INSTALLED" DRAWINGS & DIAGRAMS

Unless otherwise agreed, the Sub-contract works, or any part thereof, will only be included in a Certificate of Practical Completion when the final as installed drawings have been issued to the Supervising Officer.

Include on the "As Installed" Drawings and Diagrams the following in as far as they are the subjects of the EleC works. The general content and layout of the drawing shall be as that required for the "Installation Drawings".

i) The location, including level if buried, of Public Authority supplies provided within the Sub-contract, whether carried out by the Subcontractor or by the appropriate Authority together with the points of origin and termination, size and materials of pipes, line pressure and/or other relevant information.

ii) The layout, location and extent of all air ducts, including those formed in builder's work or otherwise outside this Sub-contract but forming part of the system, showing all dampers and other equipment, acoustic attenuators, grilles, diffusers or other terminal components. Each duct and each terminal component shall be marked with its size and the air quantity flowing, as actually measured after approved regulation of the system or as computed by the addition of such measured quantities.

iii) Single line and schematic wiring diagrams for the whole of the Subcontract works showing all terminal references and cable sizes.

iv) The layout, location and extent of all electrical plant, cable, cable tray, cable trunking, conduit, distribution boards, switches, outlets and lighting fittings which form part of the Sub-contract works, including dimensioned layouts of all concealed work. Where components are grouped or housed in a cubicle or on a common panel, and exploded arrangement must be
incorporated.

v) The layout, location and extent of all electrical plant, cable, cable tray, cable trunking, conduit switches, outlets, terminals and indicators and alarms of all ancillary communication, detection, alarm and control installations which form part of the Sub-contract works, including dimensioned layouts of all concealed work.

vi) The location and identity of each room of space housing plant, machinery, distribution boards draw-in boxes or apparatus.

vii) The detailed general arrangements, to one-twentieth scale (minimum), of all boiler house, machinery spaces, air handling plant refrigeration plant, tank rooms, switch rooms, meter rooms and other plant spaces, including the location, identity size, colour coding and details of each piece of plant and equipment.

viii) The detailed general arrangements, to one-twentieth scale of service subways, ducts, meter rooms or other special sections of the work where, in the opinion of the Supervising Officer, the small scale drawings cannot provide an adequate record.

ix) Manufacturer's drawings showing the general arrangement and assembly of component parts of all machines and any pieces of equipment which may require servicing.

x) Flow diagrams indicating the principles of the arrangements and operation of each the various services as related to central plant, other principal components and zoning of distribution etc.

xi) Diagrams illustrating the principles of automatic controls and of instruments, presented in combination with the foregoing or separately, as agreed with the Supervising Officer.

xii) Location of all earth tapes, earth electrodes and test points. xiii) In conjunction with schedules of location and details and reference, voltage and wattage of all light fittings.

xiv) Comprehensive electrical diagrams or sets of diagrams which shall show:- Size, type and length (to within one meter) of each main and sub-main cable, together with the measured conductor and earth continuity resistance of each.

xv) Manufacturer's internal wiring diagrams for each piece of electrical equipment supplied under the Sub-contract, together with physical arrangement drawings to locate and identify the component parts.

xvi) Comprehensive diagrams showing in detail all power wiring and all control wiring and/or pneumatic of other control piping executed within the Subcontract by others in accordance with detail provided by the Subcontractor, including size and type of conductor or piping used and identifying the terminal point.

1.15 Demonstration of System

The EleC shall make due allowance in his tender to provide a competent engineer to demonstrate to the client and/or his representative and individual residents, the full operation and maintenance aspects of the electrical installation two weeks prior to completion.

The persons so nominated shall make clear the following:-

a. The general layout of each system.
b. The position, functions and method of operation of each isolator, switch and controller.
c. The method of operation and control of every pump, fan, boiler or equipment so as to maintain maximum efficiency.
d. The method of cleaning component parts and the simple maintenance required to ensure proper functioning of these various items of equipment.

The EleC shall price for two number such demonstrations – initially for the client and consultant and a second demonstration for the maintenance/management company and others.

1.16 Users' Instructions

The EleC shall provide a concise set of user instructions for each installation, a copy of which shall be handed to the consultant.

The instructions shall be in the form of a small booklet and shall comprise of text, pictures and diagrams as necessary to convey all information needed to operate the installations in a proper and economical way. The instructions shall also include information such as location of incoming mains, electrical isolators and switches and similar.

The booklet shall be submitted to the consultant in draft form for comment, the consultant will then comment and adapt the instructions and issue to the residents and persons responsible for operating each installation.

2 DISTRIBUTION NETWORK

2.1 General

The EleC shall be responsible for the design, supply, installation, testing and setting to work of the complete low voltage mains distribution network.

The distribution network covers all items of equipment necessary for the distribution of electricity throughout the property, from the Electric Supply Company cable through all mains and sub-mains distribution boards to final circuit distribution boards and isolators for all large items of plant and equipment such as lifts etc.

All distribution boards shall be either surface mounted metal clad units, or recessed units where practicable. They shall be equipped with MCCB, MCB or MCB/RCD protective devices of the appropriate rating, earth and neutral bars, blanking plates, labels and circuit check lists and shall be fitted with a hinged lockable door. All door locks shall be operated by the same key.

Provision for expansion shall be made when accommodating the main switchgear and fuse gear. Similarly distribution boards shall have an allowance of 25% spare ways for future expansion.

2.2 Incoming Mains Supplies

Applications for the following electric supplies have been submitted to Electricity North West by the Engineer. The application forms the basis of;

1 No Bulk Supply of 103kva to supply the apartments and communal areas.
2 No 60kva 3 Phase supplies (1 No to each retail unit)
1 No Single phase domestic electric connection for the Duplex unit.

The electric supply quotation from ENWL shall be procured directly by the client and shall not form part of the contractors works.

The EleC shall include for co-ordination only of the new supplies.

The EleC shall design, supply and install the Main BNO Panel and all MCCB boards and sub distribution boards as detailed within the tender drawings and schematics. This shall include all sub main cabling from the substation to all sub distribution boards as indicated on the tender schematics.

The EleC shall be responsible for the design, supply and installation of all sub metering as indicated on the tender schematics.

The sub meters to the apartments shall be located within the individual apartments adjacent to the consumer units. The EleC meters shall be smart meters supplied and installed by the selected supplier.

The EleC shall be responsible for the supply and installation of all "meter tails" of the appropriate size and length, to allow connection of the required supplies detailed to the Electricity Supply Company meters. The EleC shall be responsible for the supply and installation of all Earth bars (mounted adjacent to the incoming mains distribution board) and shall consist of copper bars 25mm wide x 6mm thick and not less than 150mm long to allow connection of the building steel work, incoming services and the Electricity Supply Company earth terminal), all meter tails and all associated trunking (150mm x 150mm Steel trunking) required from the incoming service head to the switchpanel.

The EleC shall be responsible for the equipotential bonding from the main earth bar to the following equipment.

- Each individual incoming distribution system
- Any service pipes, ducting & sinks
- Exposed metallic parts of the building structure
- Lightning Protection system
- Incoming Mains Water supplies (Main Bonding)

Please note that the EleC is responsible for ensuring that all equipotential bonding is installed and connected, prior to the making live of any electrical circuits or distribution boards.

The EleC shall ensure that all sub mains distribution cabling to landlords distribution boards shall be Steel Wire Armoured (XLPE/LSF/SWA) cables with copper conductors. All XLPE/LSF/SWA cables shall be clipped to heavy gauge, galvanized perforated steel cable trays, located throughout the service risers and corridor ceiling voids as detailed on the tender drawings.

The EleC shall liaise with the Electricity Authority and the Main Contractor to ensure all builders works requirements for the supply are met and shall agree a date for the supply to be installed, commensurate with the main contractor's programme of works.

2.3 Apartments

The EleC shall be responsible for the design, supply, installation and setting to work of a surface mounted dual RCD consumer control unit to each apartment as detailed on the tender drawings. The EleC shall supply and install trunking directly above the CCU for the termination of the sub main cables.

The CCU's shall be fitted with suitably rated MCB/RCBO'S for the required protection of the final circuit wiring. The CCU shall provide an additional 2No spare ways for future use.

The proposed apartment final circuits shall form the basis of:

Dual RCD Controlled	
Cooker	45A Radial
Kitchen Outlets	32A Ring Main
Small Power Outlets	32A Ring Main
Supply to Hot Water Cylinder	20A Radial
Supply to MVHR Unit	20A Radial
Lighting	6A Radial

Smoke Detectors	6A Radial
Fridge/Freezer	20A Radial
Kitchen Outlets	32A Ring Main
Lighting	6A Radial
Intruder Alarm	6A Radial
Towel Rail	20A Radial
UFH	20A Radial
Small Power Outlets	32A Ring Main
Dishwasher	20A Radial
Washer/Dryer	20A Radial

The EleC shall ensure the consumer units comply with the IET Wiring Regulations 2015 section 421.1.201 with regards to suitable enclosures for consumer units.

The EleC shall be responsible for the supply, installation and setting to work of individual 80A SP&N switched fused isolators and tails at the meter positions (including all necessary trunking from the BNO panel, to the consumer units), to feed each of the proposed properties.

The EleC shall also be responsible for coordinating with the MeC, the services routes through the lower floors and risers, to ensure there is no conflict with the insulated pipework, cable routes and communal area lighting.

2.4 Communal Areas

The EleC shall be responsible for the design, supply, installation and setting to work of the landlords distribution boards as detailed on the tender schematic.

The distribution boards shall supply the following;

- Stairwell & Corridor Lights
- Stairwell & Corridor Cleaners Sockets
- Supply to Communal Fire Alarm Panels.
- Supplies to Lift.
- Supplies to Mechanical equipment.
- Lighting and Small Power within the reception area.
- Lighting and Small Power to Plant areas.

The EleC shall supply and install all MCB's and combined MCB/RCD's, blanking plates etc for the correct operation of the above distribution boards.

The EleC shall note that any areas subject to bare faced brick finish. The EleC shall be responsible for the supply and installations of all galvanised steel conduit for the wiring of the proposed lighting/power circuits.

2.5 Commercial Units

The 2 No Retail units on the Ground Floor shall be provided with an electric supply direct from the LV network.

The EleC shall include for co-ordination only of the incoming electric supplies.

2.6 Sub-Metering

a) In order to comply with part L of the building regulations the contractor must provide sufficient metering so that the client can attribute at least 90% of energy used to end uses.

b) The contractor shall define end uses as the client's end uses, for example, plant, back of house, circulation etc. as defined in CIBSE Guide TM39 which is referred to within Building Regulations Part L.

3 INTERNAL LIGHTING

3.1 General

The EleC shall be responsible for ensuring all wiring requirements are installed in accordance with the requirements of the IET Regulations, local building control and fire officer requirements and current British Standards.

Lighting circuits are to be run in 1.5mm^2 cable. All of the lighting system shall be wired in LSF multi-core cables. Switch drops shall be in capping. All switch boxes shall be flush steel knockout type of a minimum 25mm deep.

The EleC shall be responsible for the design, supply, installation and setting to work of the complete lighting system to all areas as detailed within this specification, as detailed on the indicative tender drawings and detailed below:

- Communal area corridors, stairwells and circulation areas throughout.
- All apartment lighting.
- Building Mounted external lighting.
- Landlord Areas including plant spaces, cycle stores and refuse stores.
- Reception Area.

The EleC shall be responsible for the supply and installation of all pattresses to ensure the correct installation of all lighting proposed (ceiling mounted and recessed).

Samples of all light fittings shall be provided for the client's approval, prior to ordering.

<u>Lighting Control</u>

The lighting to the communal areas shall generally be switched by on/off presence detection to back of house communal spaces.

The main entrances to the building and corridors shall be controlled via manual switching and left on at all times.

3.2 Apartments

The EleC shall be responsible for the design, supply, management, storage, security, wiring, installation and setting to work the complete lighting system for each property, as detailed on the tender drawings.

The EleC shall note that to comply with the current Building regulations and the air tightness/acoustic requirements, all recessed ceiling fittings within all properties shall have moisture sealed fittings and fire/smoke hoods installed to all recessed fittings to avoid the dissipation of heat into the void and subsequent moisture build up.

The EleC shall be responsible for the completion and issue of fully coordinated apartment electrical services drawings for comment by the Design Team prior to commencement of any first fix works.

The final Electrical circuits within all apartments are to be wired in LSF insulated and sheathed twin and earth cables, or three core and earth for two way lighting circuits. All cables in ceilings and the roof to run parallel to walls and vertically down walls encased in plastic conduit.

Generally it should be assumed that all runs of cable are to run within the depth of the ceiling (50mm). Where cables drop to electrical accessories they are to be protected by PVC conduit, to ensure future alterations can be carried out without chasing any walls.

All cables shall be run on the loop-in principle with all joints being made at accessory or outlet point locations. Other joints in cables will not be allowed.

Cables shall be sized in accordance with the I.E.T. Wiring Regulations with voltage drops being less than 2.5% at all points and due account taken of deratings for grouping, ambient temperature and the presence of insulation etc. The size of cables shall in no instances be less than 1.5mm^2 for lighting circuits and 2.5mm^2 for power circuits, with 10mm^2 for cookers.

Cables shall be co-ordinated with other services and the structure and care shall be taken to avoid running close to hot water pipes, and shall be protected near gas pipes.

Where conduits are buried in walls, a minimum of 12mm of cover shall be provided on any plastered walls.

Services for each flat must be kept separate at all times and services for one flat must under no circumstances enter another flat.

3.3 Communal Areas

The EleC shall be responsible for the design, supply, management, security, storage, wiring, installation and setting to work of all of the lighting to all communal areas as detailed on the tender drawings and listed below. These shall include:

- All access corridors and stairways on all floors.
- All communal entrance foyers.
- All landlord areas.
- Wall Mounted External Lighting
- Entrance Area Lighting.

The EleC shall supply, install and set to work all lighting as detailed on the tender drawings and as listed below. The EleC shall implement, supply and install all of the lighting to all of the service areas.

These areas will include the plant room, cycle store, refuge store, emergency escape corridors/stairwells. The EleC shall be responsible for ensuring all lighting levels are compliant with the recommended lux levels detailed within the CIBSE guide and therefore the numbers detailed on the drawings shall be deemed as minimum requirements only. Where light fittings are not detailed on the drawings, the EleC shall be responsible for the supply and installation of suitable luminaries.

3.4 External Lighting

The EleC shall be responsible for the design, supply, installation and setting to work of all the wall mounted external lighting as detailed on the tender drawing.

The external lighting shall be controlled via photocells and a timeclock to allow the timing to be set as required.

All luminaires shall have a degree of protection of IP54 or better.

The EleC shall ensure that care is taken not to cause glare to the surrounding properties.

The EleC shall include for an additional 5 No supplies to serve feature lighting and signs provided by others.

4 SWITCHING AND SYSTEM OF WIRING

4.1 System of Wiring

The preferred method for the final sub-circuit cabling shall be as follows:

Internal Lighting

Electrical circuits are to be wired in LSF insulated and sheathed twin and earth cables, or three core and earth for two way lighting circuits. All cables in ceilings and the roof to run parallel to walls and vertically down walls.

Generally it should be assumed that all runs of cables are to run within the depth of the ceiling (50mm). Where cables drop to electrical accessories buried in wall chases they are to be protected by PVC conduit.

All cables shall be run on the loop-in principle with all joints being made at accessory or outlet point locations. Other joints in cables will not be allowed.

Cables shall be sized in accordance with the I.E.T. Wiring Regulations with voltage drops being less than 2.5% at all points and due account taken of deratings for grouping, ambient temperature and the presence of insulation etc. The size of cables shall in no instances be less than 1.5mm^2 for lighting circuits and 2.5mm^2 for power circuits, with 10mm^2 for cookers.

Cables shall be co-ordinated with other services and the structure and care shall be taken to avoid running close to hot water pipes, and shall be protected near gas pipes.

Where conduits are buried in walls, a minimum of 12mm of cover shall be provided on any plastered walls.

Communal Corridors/Stairwells – LSF insulated and sheathed twin and earth cables. All switched via manual switching.

All landlord area wiring shall be either enclosed within galvanised trunking or conduit or run on heavy duty cable tray. The EleC shall be responsible for the supply and installation of all cable tray.

Areas where PIR/Movement switching is not appropriate (i.e. plant rooms), lighting switches shall be rated 20A double pole 230V and shall be of the surface mounted metalclad type.

Electrical circuits within the flats are to be wired in LSF insulated and sheathed twin and earth cables, or three core and earth for two way lighting circuits. All cables in ceilings and the roof to run parallel to walls and vertically down walls.

Generally it should be assumed that all runs of cable are to run within the depth of the ceiling (50mm). Where cables drop to electrical accessories buried in wall chases they are to be protected by oval PVC conduit

5 SMALL POWER

5.1 General

The EleC shall be responsible for the design, supply and installation of all small power requirements for all of the communal areas (internal/external), plant space and all apartments detailed within this specification and on the indicative tender drawings, all issued as part of this tender package.

The EleC shall ensure that small power outlets are provided to the areas detailed below. Small power outlets shall include the following;

- All mechanical Plant
- TV & Satellite Systems
- Fire Alarm Systems
- Telephone Systems
- Door Entry Systems
- All landlord and communal areas
- All apartment small power
- Door intercom systems

All small power outlets and light switches within the apartments shall be from the Click Definity Range (Black Finish). A Samples board must be provided to the client for approval prior to ordering.

The media plates within the apartments shall be from the Scolmore New Media Range MP606PW.

All small power outlet back boxes shall be metal clad, fixed to noggins supplied by the main contractor and detailed clearly on a marked up drawing by the EleC.

All putty pads shall be supplied and installed by the dry lining contractor; however the coordination shall remain the responsibility of the EleC.

All switch controls for appliances and equipment should be etched with the name of the specific appliance.

The EleC shall be responsible for the supply and installation of the small power requirements for all of the apartments.

Numbers of socket outlets for each room shall be as detailed below and on the tender drawings. The EleC shall be responsible for confirming positions and heights of sockets (to comply with Part M), particularly within the kitchen (in conjunction with the Designer).

The kitchens are to be installed by a specialist kitchen contractor and the EleC shall liaise with him also to ensure the exact electrical requirements of the kitchen are met. Generally within each kitchen and apartment the EleC shall allow for the following:

- Cooker (45A) & Hob supply and low level connection plate
- Dishwasher supply and low level connection plate
- Fridge/Freezer supply and low level connection plate
- Washer/dryer machine supply and low level connection plate
- An additional 2 switched fused spurs per apartments for Employer supplied appliances

All low level, connection plates for the above shall be switched via switched fused connections units clearly labelled, at a position to be agreed with the Designer above counter level. In addition the EleC shall supply and install the following:

- Cooker extractor hood supply
- At least 3 No. twin switched socket outlets above the kitchen counter level.

The EleC shall be responsible for the final connection of all appliances.

In addition, the EleC shall be responsible for the supply, installation and setting to work, within each apartment bathroom/En Suite, of a flush mounted dual voltage shaver point, as detailed on the tender drawings.

5.2 Communal Areas

The EleC shall be responsible for the supply and installation of adequate small power outlets for cleaning and maintenance purposes. The service sockets shall be wired on separate ring main circuits from the communal distribution boards, clearly identified and isolated via key switches with neon indicators, located within the service riser on each corresponding floor. All service sockets shall be RCD protected. Within corridors, sockets shall be installed every 10m of corridor or part thereof. Where doors divide corridors, there should be at least one such socket in each section. Within stairways sockets shall be located at each floor level.

5.3 Television/Satelite Systems

The EleC shall be responsible for the design, supply, installation and setting to work of an Integrated Receiving System (IRS), television and satellite system. The EleC shall be responsible for ensuring the television system is designed accordingly to ensuring no reduction in the standard of signal strength at any given property. The Safety, performance, and system design shall be in accordance with BS EN 50083 Part 1 – 10, Radio/TV system in accordance with BS 6330, BS 6513 and BS EN 50083 (as Sky Homes Registered Sky Homes Installer).

The system shall comprise of the following:-

- Digital Terrestrial Channel multiplexes
- RSL Analogue
- Digital Satellite Channels
- FM Stereo Channels (Local and National to area)
- DAB Channels (Local to Area if available)

The EleC shall be responsible for employing a TV distribution and reception specialist for the detailed design, supply, installation, connection, testing, commissioning and setting to work of a complete and operational IRS to the above requirements. The works shall include for the supply and installation of all aerials, fixings, brackets, cabling, amplifiers, final outlet plates and head end equipment within the property, landlord areas and service risers. The specialist should be a member of the CAI group of registered installers following the codes of practice issued by the CAI. Amplifier covering frequencies 40-860 MHZ necessary to amplify the incoming TV signals.

The system shall be installed in conjunction with the Sky Homes Specification for a Co-axial Integrated Reception System (Incorporating digital Channel Stacking Technologies – Sky Q compatibility) and shall be installed to allow Sky Q reception to all TV points (lounge) within all properties.

The EleC shall be responsible for the supply and installation of all electrical small power requirements to ensure the correct operation of the television and satellite system.

The EleC shall be responsible for all containment (cable tray/trunking – wires must not be draped over false ceilings), to ensure all cabling is adequately segregated from mains voltage cabling, luminaires and other equipment.

Specifications

The systems must conform to the following standards and codes of practice:

- BS EN 50083-2/FPRA1 all relevant parts
- BS EN 50117-1:2002+A2:2013 for coaxial cables
- BS EN 60966 for connecting cables
- BS 4662:2006+A1:2009 Specification for boxes for the enclosure of Electrical Accessories
- BS 5733:2010+A1:2014 - General requirements for electrical accessories. Specification
- SCR Standard (auto detect & switch) - Sky SCR Software v2.6 (May 2015) – requires diseqc 1.0 or higher – with Sky proprietary extensions, CENELEC EN 50494, CENELEC EN 50607, Universal LNB Tone & Volts
- The Confederation of Aerials Industries current Codes of Practice for Television Aerials, and TV Systems
- The Confederation of Aerial Industries current Codes of Practice for Electrical Safety Requirements for Signal Reception Systems
- The requirements of the DTG R-book 5 in respect of the system for the Digital Terrestrial services (except to the extent that technical differences apply, when this Specification will override DTG R-book 5)
- IET regulations (latest edition)
- BS 7671:2008+A3:2015 - Requirements for Electrical Installations

Satellite Dish and Aerials Multi-Switches.

The EleC shall be responsible for ensuring all aerials shall be of the appropriate group and type for the area and also provide the required reception levels. All aerial arrays to be capable of withstanding forces resulting from wind velocities of up to 100 mph and details of any installation requirements to be supplied prior to installation. The aerial / dish installation to be fully bonded to the lightning protection system or earth bonded and the location and fixing of aerials and/or masts to be agreed prior to installation. Multi-switches/splitters/taps/launch amplifiers to be installed at appropriate locations and line powered from the central head-end position. Positions for the aerial installation must be agreed with the Designers prior to the commencement of any first fix wiring.

The satellite dish shall be located at roof level, cabling from which will serve the main amplifications units situated within the main service risers. The EleC will be responsible for the supply and installation of all small power requirements for the correct operation of the television/satellite system.

The EleC shall be responsible for attending site as early as possible, once access is made available, and confirm the signal strength prior to commencement of any first fix works. Confirmation of the signal strength must be provided prior to any on site works being authorised and approved.

Earth Bonding

The system must be earthed, via a minimum 4mm2 earth Cable, taking into account the CAI Code of Practice on Earth Bonding and the requirement to maintain no more than a 5 ohm loop resistance, to the Buildings PME. Where individual buildings share an installation the earth must be connected to the relevant Building PME.

Materials

All materials must be new and previously unused. All goods and materials used in providing the system shall conform to EU and national standards, where such standards have been established, and to the Codes of practice issued by the relevant industry bodies.

All amplifiers and distribution equipment shall be by a Sky Homes partnering supplier, whose equipment has been tested and passed set top box compatibility testing.

All Equipment must be able to cope with the minimum and maximum signal levels, as approved, in the CAI SMATV Code of Practice and those levels listed above for the given frequencies in use.
No departure from the specified and/or approved materials will be accepted.

Television and Audio Aerials

The aerials will be from an approved supplier and comply with the CAI Code of Practice.
All UHF antennas must incorporate a Balun to ensure the matching of the dipole to the feeder cables.
The aerial system, mounts, support structures etc. Must be capable of withstanding winds of 100mph/160kph.

Cable Types and Fixings

All cables shall be manufactured to the relevant parts of Specification BS EN 501171:2002+A2:2013.

All cables must have passed the benchmarking approval test as conducted by the Confederation of Aerial Industries Ltd. And have a certificate issued by the Confederation of Aerials Industries Ltd. That the cable meets with the benchmarking approvals.

All co-axial cables shall be CAI benchmarked approved digital cable and of type 100/125/165 only.
For an update on supplier list please visit www.cai.org.uk.

All coaxial cable shall have a nominal characteristic of 75 ohms and will be suitable for the application concerned. The Contractor should take into account any requirements for special cable constructions such as LSZH (Low Smoke Zero Halogen)

Internal cables, located in building risers, must be fixed to a cable tray or located within an enclosed conduit or trunking.

Any cabling that is run across fire escape routes and/or in communal areas which can be deemed as an escape route and used for access or egress in the event of a fire must comply with IET Wiring Regulations (BS 7671:2008+A3:2015).

Socket Outlets

The system must be connected to at least one socket outlet in every home. All socket outlets must be fully screened, surface or flush mount type, and have a minimum of four connecting points. Individual sockets shall be provided for TV, Satellite1, Satellite 2, and Audio (covering both FM and DAB frequencies) and must comply with BS 5733:2010+A1:2014.

Where extra slave RF outlets are provided, within an individual dwelling, then a return path outlet should be provided to enable the connection of a co-axial cable to a distribution amplifier. Any extra outlets should provide sockets for TV and audio signals.

The EleC shall refer to the below link for the latest Sky Homes Specification (New Build MDU).

https://communaltv.sky.com/media/49464/sky-new-build-irs-mdu-2015.pdf

A schematic plan representing the installed system in block diagram form, showing locations of equipment, types of cables and earthing arrangements must be submitted to the Developer for final approval.

5.4 Door Entry Systems to Apartments

The EleC shall be responsible for the design, supply, installation and commissioning of the complete door entry system and access control system to this development. The door entry system and access control system shall comprise the following;

Duplex Apartment

- Comelit VIP Video Door Entry Kit (8531 c/w Icona Monitor)

The above kit consists of 1 external unit for VIP Kit 4894HIM, 1 power supply unit art 1595, 1 power supply unit art 1441B, 1 slave gateway art 1456S, 1 Icona monitor art 6602WK, 1 flush mounted box art 6117, 1 wall mounted bracket art 6620. The kit is pre programmed and ready to use. 1456S gateway configuration shall be carried out via an internal web server.

Main Apartment Entrance

- 1 No Digital Ikall Metal Panel (VIP System) Ground Floor Main Entrance.
- Fob Reader access Control System to all other external doors (Simplekey advanced fob reader SK9001I)
- Video and Audio Receivers in each apartment linked to main entrance doors (Icona Indoor Units 6602W).
- Multi user gateway + slave licences for apartments (To allow door entry to be linked to a Smartphone).
- 50 No fobs.

The EleC shall include for all power supplies to include a full working system.

The access control system shall include the below;

- Proximity Readers
- Exit Buttons
- Green Break Glass Units

Door entry system to be a Comelit Ikall Video System;

Comelit Group UK Ltd
Unit 4,
Mallow Park,
Watchmead,
Welwyn Garden City,
Herts AL7 1GX

Equal or approved manufacturers will be considered if identified by the EleC at tender stage.

5.5 Telephone and Broadband Systems

The EleC shall be responsible for the design, supply, installation and setting to work of the complete telephone and broadband system to all properties within the building.

The telephone and broadband shall be provided by a BT Fibre Installation.

The system shall be installed in accordance with the BT Openreach Developer Guide for Fibre networks.

The incoming fibre shall terminate in the electrical plantroom into a fibre box/splitter which needs to be installed at a minimum height of 200mm and a maximum height of 1500mm AFFL.

At the incoming BT fibre position(s) the EleC shall leave a minimum of 2 meters slack for final connection by BT and ensure each property supply cable is clearly identified. The EleC shall be responsible for liaising with BT to ensure all property final connections to the incoming mains BT point is programmed and actioned in line with the new owners occupation times (note this will be after completion and at different times).

The EleC shall include for additional fibre boxes/splitters which shall be located in the risers throughout the development. The boxes/splitters will be connected by fibre cable.

The EleC shall include for an additional copper service for all lift lines, CCTV and door entry systems.

Each property shall have an ONT (Optical Network Termination) and BBU (Battery Back up) wired back to the secondary fibre joint box within the riser cupboard. The EleC shall include for a twin switched socket adjacent to the ONT & BBU.
The BT Router shall be located adjacent the ONT & BBU.

The EleC shall include for all additional data cabling from the ONT & BBU to each RJ45 socket within the apartment as indicated on the apartment layouts.

Cat 6 cabling shall be provided to all additional RJ45 sockets for future proofing.

All BT wiring shall be clipped to suitably sized steel cable tray from the BT incoming position through communal areas/risers to each final connection position within each apartment. All cable and cable tray shall be supplied and installed by the EleC.

The RJ45 face plates shall match the apartment small power face plates. Flush mounted data points only will be acceptable.

The EleC shall allow within their tender to attend site after completion to connect the apartment ONT if these are to be wired by BT and for the coordination of all BT final connections in conjunction with the occupation of the apartments.

The EleC shall be responsible for liaising with BT to ensure all works are carried out prior to project completion.

5.6 Lightning Conductor

The EleC shall be responsible for all costs associated with employing a specialist contractor to implement, supply, install and setting to work a (LPS) lightning protection system to the building. This shall incorporate a 15x15 metre high level air termination conductor mat at roof level on the different levels of the development, connecting to a series of down tape conductors that shall terminate at ground level into earth electrodes complete with inspection pits. The protection shall extend and include all incoming and outgoing services lines, with class 1 protection at the incoming LV positions and class 2 on all other outgoing connections. The preferred LPS equipment manufacturer shall be `Furse`.

5.7 Redcare Telecom Facilities

The EleC shall be responsible for arranging for the provision of a dedicated British Telecom redcare line for the Fire Alarm prior to commissioning.

The lines will be applied for on behalf of the client, as such the EleC will liaise with the client and provide all necessary paperwork to be completed by the client.

All containment for this installation and associated power supplies will be provided by the Electrical Services Contractor.

All BT and Data wiring shall be clipped to suitably sized steel cable tray.

The EleC shall be responsible for ensuring all telephone and Data cabling is ISDN/Broadband Compatible and Broadband (ASDL) is provided throughout.

The EleC shall be responsible for the supply of all back boxes, flush face plates and the final connection of the telephone/Data points. The only final connections not the responsibility of the EleC shall be at the incoming BT position. The telephone face plates shall match the local small power outlet finish detailed earlier in this specification. Flush mounted telephone points only will be acceptable.

At the incoming BT position and within the communications room, the EleC shall leave a minimum of 2 meters slack for final connection by others and ensure each cable is clearly identified. The EleC shall be responsible for liaising with BT to ensure all property final connections to the incoming mains BT line is programmed and actioned in accordance with the main contractors programme.

The EleC shall be responsible for all costs associated with the installation of the redcare packages for the above.

All Telephone and Data wiring shall be CAT 6.

5.8 Simply IP Installation

The EleC shall be responsible for the design, supply, installation and setting to work of a hard wired IP system to provide Telephone and Broadband facilities to each apartment and retail unit.

The system shall comprise the following;

- Roof mounted Microwave dish and antenna to a designated position.
- 600 (wide) x 600mm (deep) x 350mm (high) data racks to be located in a communal space where the Cat 6 cabling is wired back to. Rack/cabinets can be floor or wall mounted.

  Locations of Data Racks to be agreed with the architect.

  The racks will house patch panels for the Cat6 cabling and then switches to patch into.
- 600mm (wide) x 800mm (Deep) x 650mm (High) rack/ cabinet in a riser near to the roof of the designated communal space to locate the core network equipment in.

  The roof rack will connect by one fibre to the dish and antenna on the roof and will house routers and switches for the core network infrastructure.

The EleC shall include for all Cat 6 cabling to each of the apartments and ground floor retail units back to the data racks in the designated communal space and all associated switches.

The Simply IP installation shall include a connection (Master Socket) to the retail units on the ground floor.

The EleC shall include for all power supplies required to ensure a complete working system. A clean 13 amp fused connection unit will be required adjacent to each data rack.

The EleC shall ensure all builderswork for this item is included within the tender costs.

The EleC shall contact Simply IP Limited for a quotation;

Simply IP Limited, Floor 2, Wing 2, Delta House, Wavell Road, Manchester, M22 5QZ.

Tel: 07909 253999

mark@simplyip.net

5.9 Electric Panel Heaters & Towel Rails– Apartments

The EleC shall be responsible for the supply, management, storage, security, wiring, installation and setting to work of all Electric Panel Heaters and Towel Rails to the apartments including all power supplies as indicated on the tender drawings.

The electric panel heaters shall be from the Adax Neo range in a Black finish.

The panel heaters within the apartments shall be controlled by a heating programmer as the Heatmiser Neo-stat or equal and approved. A control hub shall be provided to enable wireless connectivity and user control of the heating system via a smartphone application. The control hub shall be the Heatmiser neo Hub model or equal and approved.

The EleC shall be responsible for the procurement of the above Heatmiser equipment.

The system shall provide time and temperature control to the panel heaters.

Electric towel rails shall be provided in wet rooms as Adax The Bray straight chrome heated towel rail or equal and approved. Time control shall be provided using the TimeGuard FST-77A Fused Spur Timer or equal and approved.

A sample must be provided for the Employer for approval, prior to the ordering of any electric panel heaters and towel rails.

The EleC shall obtain the heater sizes from the Mechanical Contractor as they will be responsible for the design and heat loss calculations.

Equal or approved manufacturers will be considered if identified by the EleC at tender stage.

5.10 Electric Underfloor Heating – Apartments and Communals

The EleC shall be responsible for the supply, management, storage, security, wiring, installation and setting to work of the Electric Underfloor Heating System to the apartments and communal spaces including all power supplies as indicated on the tender drawings. The system shall be the deviflex DTIP-10 system or equal and approved.

The MeC shall be responsible for the design and final sizing only of the electric underfloor heating system.

The final sizes of the electric underfloor heating shall be determined by the MeC with procurement of the electric underfloor heating by the EleC.

The electric under-floor heating system shall be installed within the floor screed or within the joists with suitable reflector plates complete with insulation; the EleC shall ensure that the builders work requirements to accommodate the under floor heating installation are agreed with the architect and incorporated into the design.

The under floor heating installation shall include the following:-

1. Floor insulation;

2. Perimeter edge insulation;

3. Polythene membrane;

Each area served by the under floor heating system shall be installed in separate zones as indicated on the tender drawings.

The under floor heating system shall be designed to BS EN 50559:2013 and use floor surface temperature limits specified by that norm.

The under floor heating system shall carry full BBA approval, with respect to the whole system.

5.11 PV Installation

The EleC shall be responsible for the design, supply, installation and setting to work of a PV system to the roof to include 3kWp of photovoltaic panels.

The EleC shall employ a specialist contractor to install the PV panels. The specialist contractor shall be certified under the Microgeneration Certification Scheme (MCS) so that the installation shall remain eligible for feed in tariff payments.

The complete installation shall consist of the following;

1. Roof mounted solar array collector.
2. Solar Array DC to AC inverter.
3. Total on site generation meter.
4. Electrical supplies and connections to roof and main landlord's electrical system.
5. A display unit to be located in the ground floor plantroom to indicate the energy being generated.

The EleC shall be responsible for co-ordinating with the specialist contractor to ensure all power supplies are installed to provide a fully working installation.

5.12 Wondrwall System

The EleC shall be responsible for the design, supply, installation and setting to work of a Wondrwall System to each apartment.

The system shall replace the standard light switches within each apartment to provide an intelligent system which shall control the lighting, heating and security within the apartment.

The EleC shall include for the following components within each apartment;

- Smart Light Switches (Quantities as shown on the Lighting Drawings).
- Smart Fob – 2 No per apartment.
- Smart Thermostat – 1 No per apartment.

The EleC shall contact Wondrwall for a quotation;

Wondrwall Ltd
3 Hardman Square
Spinningfields
Manchester
M3 3EB
Tel: 0161 457 0315
E Mail: hello@wondrwall.co.uk

The EleC shall include for all power supplies required to ensure a complete working system.

6 EMERGENCY LIGHTING

6.1 Communal Area

The EleC shall be responsible for the design, supply, installation and setting to work of the complete emergency lighting system to all communal/landlord areas in accordance with the following, the tender drawings and the lighting schedule issued with this specification:

Statutory Documents

- Fire Precautions Act 1971
- Health & Safety at Work Act 1974

British Standards

- BS 5266 Part 1.
- BS 4533 Section 102.22: 1990
- BS 5499 Part 1 & Part 3 1990.

European Directives

- The Workplace Directive (89(654)EEC(23)
- The Constructions Products Directive (89(106)EEC(24)
- The Health & Safety Signs Directive Regulations 1996

Employer

- The indicative tender drawings

The EleC shall be responsible for ensuring the wiring of the emergency lighting system is in accordance with the local building control and fire officer's requirements.

The system shall include all fittings, wiring, test switches etc. The EleC shall note that all emergency lighting within communal stairwell and corridors shall be maintained to ensure sufficient background lighting is maintained.

The EleC shall ensure the emergency lighting system covers the routes from the escape doors/routes on all facades of the property to the street position at the front of the property. This includes all changes in level and walkways.

6.2 Emergency Light & Signage Test Facilities

"Secret Key" test switches shall be fitted within the lighting grid switch plates (or separate grid switch where PIR operated); by controlling the individual permanently by live charger/sensor circuits to the emergency light fittings. On operation of the test switch the charger/sensor circuit shall be broken causing the emergency light fittings to be illuminated in the emergency mode.

All switch plates containing test switches shall be engraved "Emergency Lighting Test" at the test switch position, and located within the service riser upon the corresponding floor.

7 FIRE ALARM SYSTEM

7.1 Communal Areas

The EleC shall be responsible for the design, supply, installation and setting to work of the complete fire alarm system to cover the communal/landlords areas of the development.

General

An addressable fire detection and alarm system shall be installed to cover areas as indicated on the tender drawings. The system shall comply with the requirements of BS 5839: Part 1 and shall provide a minimum type "L5" level of protection covering the whole of the building, in compliance with the requirements of the local Building Control, Fire Authority, Health & Safety Executive and the Building Insurers.

The EleC shall be responsible for ensuring the complete fire alarm system is installed in accordance with the performance specification and tender drawings issued with this tender.

The Fire Alarm Panel shall be EN54 approved and be manufactured by Protec and commissioned by the fire alarm manufacturers approved agents. Protec Addressable Fire Alarm Panel.

Protec Fire Detection
Protec House
Churchill Way
NELSON
Lancashire
BB9 6RT
Tel. 01282 717171
Email. sales@protec.co.uk

An equal or approved manufacturer may be considered if detailed by the EleC at tender stage only.

Equipment

The fire alarm system shall consist of an addressable type system comprising the following. The EleC shall be responsible for ensuring all requirements and equipment detailed within the following are installed as per the manufacturers requirements:

Digital Addressable Fire Alarm Panel

viii) Digital Addressable Control Panel (mimics and main panel recessed at 1.7m.f.f.f.l).

ix) The EleC shall be responsible for the sizing, supply and installation of the required battery back-up packs, which are not supplied with the panel. The EleC shall be responsible for checking the loop current load and sizing the batteries accordingly.

x) The EleC shall ensure the fire alarm panel is programmed to indicate a fault signal every 3 months, if the regular maintenance of the fire alarm panel has not been carried out. The fault shall be set for a 3 week band from the anticipated maintenance visit and shall highlight "Service Due Date".

xi) All connections made within the fire alarm panel must be via crimped lugs.

xii) Supply and installation of all interface units (24V & 240V) for the proposed mechanical plant, lift etc. Lift shall return to Ground Floor on fire alarm signal and doors open.

Detectors, Sounders and Associated Equipment

viii) 1 Loop Addressable Control Panel in Eco Housing

ix) Optical Smoke Detector

x) Heat Detector (Static + RoR)

xi) Standard Detector Base for Cerberus PRO

xii) Sounder Base for Cerberus Pro Detectors

xiii) Manual Call Point - Flush Mounting

xiv) Surface Mounting Backbox for FDM225 Manual Call Point

xv) Alarm Sounder Beacon (Red) 80-99dBA

xvi) Addressable Base for Loop Powered Sounder

xvii) Single Way Input/Output Module

xviii) Housing for Cerberus PRO I/O Modules

xix) When the fire alarm goes into alarm a numerical alarm display will be indicated in the panel. Please note that this alone will not be acceptable and an LED must be illuminated on the device signalling alarm. All LED's shall be off and illuminate on alarm, blinking LED's are not acceptable.

xx) Each proposed loop shall have a maximum of 126 detectors installed, with the loop current not exceeding the manufacturer's recommendations of 500mA per loop.

xxi) Short circuit isolators shall be installed to protect to loop wiring from short circuit faults. These shall fitted onto a base mounted sounder and be a maximum of ten addresses apart.

The EleC shall also include for the following:

i) Commissioning of the system on completion.

ii) Programming the system to achieve customisation to suit site conditions.

iii) All attendance on fire alarm manufacturers commissioning engineers during their commissioning period.

iv) All attendance on fire alarm manufacturers commissioning engineers for the final interface and commissioning with the existing school.

v) Providing Employers instruction at handover.

vi) Coloured Zone Chart - indicating each address etc.

Electrical Supply (240 volt A.C.)

A dedicated fire resistant circuit shall be installed which shall terminate adjacent to the fire alarm panel via an un-switched fused connection unit engraved “FIRE ALARM SYSTEM, DO NOT SWITCH OFF” This warning should also appear on the circuit markings at the distribution board. The fire alarm panel shall be fed from the Essential Distribution Board within the ground floor switchroom.

Wiring Systems & Controls

The EleC shall be responsible for ensuring the wiring system installed is in accordance with the local building control and fire officer’s requirements.

Generally the fire alarm system wiring shall be installed using Delta fire tuff cable with copper conductors and sheath, with red LSF oversheath, 750-volt grade to 240-volt AC circuits, 500-volt grade to ELV circuits. The EleC shall be responsible for confirming the cabling detailed above is acceptable at tender stage.

An interface shall be installed to each of the following:

Mechanical Distribution Boards

All Lifts

Access Control Operated doors

Sprinkler System, allow an interface per flow switch on each floor.

Ground Floor Fire Curtain

2 No Retail Units

The EleC shall be responsible for calculating and wiring the number of loops required in accordance with the manufactures requirements for device and address number and loop current.

Note:

Each side of the loop cable shall be installed as a separate cable and shall not be contained into a single multicore cable.

i) Wiring shall be concealed in all areas.

ii) At break glass contacts the cables shall terminate directly into the proprietary wall box.

iii) Single point detectors (smoke and heat type) terminate fire tuff cable into a circular conduit box and mount detectors directly onto the conduit box.

iv) In agreed locations isolation units shall be installed these shall be mounted directly onto either an accessory box or circular conduit box as appropriate.

v) The fire alarm installer shall issue a working drawing before work commences.

vi) The fire alarm manufacturer shall be on site to witness the required tests to each loop cable before connection to bases.

vii) System cabling shall terminate directly into the fire alarm panel.

Programming

Include for all necessary "off site" and "on site" programming of the system by the Manufacturers Approved Engineer, to customise the operation of the system, the sequence of operation and information displayed (i.e. zone indication and allocation).

Commissioning

Include for commissioning the complete system by the Manufacturers Approved Engineer and obtain a completion/commissioning certificate, which shall form part of the record documentation to be handed to the Employer on Contract completion.

The EleC shall include for providing all necessary instruction to the Employers nominated representative by the manufacturers engineer and at a date and time nominated by the Employer.

Fire Curtains

The EleC shall include for a fire alarm interface and power supply to the fire curtain in the following areas;

- Ground Floor entrance area.

Power Supply Cut out to Hob

The EleC shall include for a hob cut out to each apartment to ensure that the power supply to the hob is isolated in the event of a fire within that apartment.

This shall be achieved by the provision of a relay base within the heat detector in the kitchen wired back to a relay within the main consumer unit.

To trip the MCB the contactor would have to be wired in such a way as to generate a "fault" that could trip the breaker. Thereby ensuring that when the fire alarm is reset the MCB remains tripped keeping the circuit off until such time as the occupier resets their own breaker.

The above shall be mentioned in the tenants handbook prior to handover.

The EleC shall ensure compliance with the current Fire Strategy.

7.2 Separate Mains Fire Detection within each Property

Within each property the EleC shall be responsible for the design, supply and installation of mains operated self-contained smoke and heat alarms to BS 5466: Part 1, to comply with the requirements of Part B1 of the Building Regulations.

The EleC shall include for a Category LD1 Grade D system to all apartments designed and installed in accordance with BS 5839-6. This category of system requires all areas of the building to be protected with automatic fire detectors, with only a few exceptions, e.g. toilets and bathrooms, small cupboards, etc. A system of one or more mains powered smoke alarms, each with an integral standby supply. (The system may, in addition, incorporate one or more mains powered heat alarms each with an integral standby supply).

8 SECURITY SYSTEMS

8.1 CCTV Installation – Communal Areas

The EleC shall be responsible for the design, supply, installation and commissioning of a new CCTV installation as detailed below and on the tender drawings. The new CCTV installation shall be installed to the NACOSS Code of Practice (NACP20).

The new CCTV system shall comprise the following;

External fixed head cameras to cover all the entrances/exits to the building. CCTV cameras to be high performance fixed head cameras.

Internal fixed head cameras to be located in the communal areas as detailed on the tender drawings.

One number Monitor 21" colour, located in the ground floor plantroom.

One number 16 input colour digital video recorder Minimum 160 Gb h/d & cd, located within the ground floor reception office with the facility for remote reading.

CCTV Matrix C/w Telemetry controller

In addition to the above, the EleC shall be responsible for the supply and installation of the following:

- 2 No. Twin socket outlets at a position to be agreed for remote recording (monitor & recorder).
- Lockable IP65 rated supplies to all camera positions

All cameras are to have a resolution of greater than 480TV Lines.

The external cameras shall be wall mounted each fitted with inside thermostatically controlled, electrically heated IP65 sheet steel vandal resistant enclosures finished in epoxy powder coating with concealed wireways. Colour of housing to be agreed with the Client/Design Team.

The CCTV Installation shall be supplied by Protec Fire Detection, please contact the below for a quotation;

Protec Fire Detection
Protec House
Churchill Way
NELSON
Lancashire
BB9 6RT
Tel. 01282 717171
Email. sales@protec.co.uk

An equal or approved manufacturer may be considered if detailed by the EleC at tender stage only.

The EleC shall ensure that the CCTV installation is in compliance with the Crime Impact Statement.

9 HVAC & MECHANICAL PLANT WIRING

9.1 Ventilation Systems

All ventilation fans and controls shall be supplied by the MeC and wired and connected by the EleC from suitably rated circuit breakers (motor rated where applicable). All fans shall be wired via suitably rated local isolators, with the final connection and setting to work of all ventilation fans being the responsibility of the EleC.

The EleC shall include for the following supplies to Ventilation Systems;

- MVHR Units to apartments.
- Supplies to Smoke Ventilation System

9.2 Domestic Hot Water Boiler Plant

The EleC shall be responsible for the supply and installation of the following electrical supplies to mechanical plant proposed:

- Fused connection units/isolators to the packaged booster set within the ground floor plant room.
- Supplies to sprinkler systems.
- Supplies to hot water cylinders within the apartments.

The EleC shall liase with the mechanical contractor and ensure all power supply requirements are confirmed in line with the above.

The EleC shall include for all power supplies to the Mechanical equipment as indicated on the tender drawings.

10. LOAD BALANCE AND PHASING

The total load shall be balanced as far as is practicable across the three phases.

All lighting and power in any one area shall be connected on the same phase. The Contractor shall check the direction of rotation of all motors to ensure that they turn in the correct direction.

11. TESTING AND COMMISSIONING

On completion of the installation the EleC shall test the whole of the installation and shall prepare the Completion and Inspection Certificates as prescribed by the IET Wiring Regulations, and hand copies to the EA. He shall also affix to all distribution boards the notice of periodic inspection as detailed in the IET Wiring Regulations and complete the dates on the notices.

In addition the EleC shall, immediately a supply is available, carry out an earth loop impedance test to determine that Ze is equal to or less than the figure on which all design calculations have been based. Should this not be the case, calculations shall be revised, and proof provided that the proposed installation complies with the IET Wiring Regulations.

12. PERFORMANCE TESTING

Performance testing will be undertaken by the Contractor to demonstrate, by measurement and recording that an installation functions correctly and that the Emergency lighting and Fire Alarm system satisfy the requirements of Building Control/Fire Officer.

Performance testing of an installation shall only take place on completion of commissioning and shall be to the requirements of the Employer. Upon successful completion of the testing, the Contractor shall prepare the necessary Emergency Lighting and Fire Alarm Certificates, and hand copies to the EA.

13. BUILDERS WORK

The EleC shall be responsible for marking out all chases for conduits and wall boxes.

The EleC shall allow in his tender for the provision to the Main Contractor of 2 sets of "builders work" drawings showing the location, width, depth and length of all chases and trenches, the position and size of all holes through walls, floors and ceilings and full details of any additional builders work that he may wish to carry out or be carried out by others.

All conduits, trunking, tray work and cables taken through fire barriers of whatever nature shall be adequately sealed to reinstate the integrity of the fire barrier. Generally this shall require the application by the EleC of intumescent mastic in and around the conduit, trunking or tray at the point of penetration of the barrier.

Unprotected cables taken through a fire barrier shall be sleeved at the point of penetration. Within the roof/ceiling space where cables are run unprotected, it may prove necessary to take cables through fire curtains, and the EleC shall ensure that the curtain is tight around any bales at the point of penetration to eliminate the passage of smoke and flame.

14. HANDOVER PACKAGE

At handover, the EleC shall be responsible for the provision of the following:

Spare lamps

- Spare lamps for each light fitting type, lamps for 10% of the overall number of light fittings.
- 1 No. Laminated lamp schedule per apartment, indicating all installed fittings and the corresponding lamp required
- 1 No. Laminated lamp schedule, indicating all installed fittings, both communal and service areas and the corresponding lamp required (plus 1 No. copy within each manual).

Fire Alarm

- 4 No. spare break glasses.
- 1 No. Laminated zone chart per system (plus 1 No. in each manual).
- 1 No. Laminated instructions sheet per system (plus 1 No. in each manual).
- 4 No sets of all test keys and panel keys.

Distribution Boards

- 1 No. Laminated circuit chart for each distribution and sub distribution board.
- 4 No sets of all keys.

Emergency Lighting Fittings

- 4 No sets of all test keys.
- 4 No sets of fixing keys.

Test Certificates

- Fire alarm, emergency lighting and electrical installation and testing.

Record Information

2No. hard bound copies of record drawings and O&M manuals.

Section 4

Summary of Tender

Section 4 – Electrical Summary of Tender

Please note that the summary must be completed in full. Any returned tender summaries not completed fully will be discounted.

For any clarifications during the tender period please contact Daniel Watt at WE&CE Ltd on 0161 434 3103.

Section	Description	Cost (£)
1	INTRODUCTION	
1.1	General	
1.2	Responsibility During Defects Liability Period	
1.3	General Scope of Electrical Works	
1.4	Insurance Liability Cover	
1.5	Construction Stage Responsibilities	
1.6	Post-Project Responsibilities	
1.7	Attendances & M & E Co-ordination Meetings	
1.8	Part L Compliancy	
1.9	Operating and Maintenance Instructions	
1.10	Tenants' Instruction/Handbooks	
1.11	Temporary Electrical Supplies	
1.12	Builder's Work	
1.13	On Site Record Drawings	
1.14	'As Installed' Record Prints	
1.15	Demonstration of System	
1.16	Users' Instructions	

2	DISTRIBUTION NETWORK	
2.1	General	
2.2	Incoming Mains Supply	
2.3	Apartments	
2.4	Communal Areas	
2.5	Commercial Units	
2.6	Sub-metering	
3	INTERNAL LIGHTING	
3.1	General	
3.2	Apartments	
3.3	Communal Areas	
3.4	External Lighting	
4	SWITCHING & SYSTEM OF WIRING	
4.1	System of wiring	
5	SMALL POWER	
5.1	General	
5.2	Communal Areas	
5.3	Television/Satellite Systems	
5.4	Door Entry System to Apartments	
5.5	Telephone and Broadband Systems	
5.6	Lightning Conductor	

5.7	Redcare Telecom Facilities	
5.8	Simply IP Installation	
5.9	Electric Panel Heaters & Towel Rails– Apartments	
5.10	Electric Underfloor Heating – Apartments and Communals	
5.11	PV Installation	
5.12	Wondrwall System	
6	EMERGENCY LIGHTING	
6.1	Communal Area	
6.2	Emergency Light & Signage Test Facilities	
7	FIRE ALARM SYSTEM	
7.1	Communal Area	
7.2	Separate Mains Fire Detection within each Property	

8	SECURITY SYSTEMS	
8.1	CCTV Installation – Communal Areas	
9	HVAC & MECHANICAL PLANT WIRING	
9.1	Ventilation Systems	
9.2	Domestic Hot Water Boiler Plant	
10	LOAD BALANCING & PHASING	
11	TESTING & COMMISSIONING	
12	PERFORMANCE TESTING	
13	BUILDERS WORK	
14	HANDOVER PACKAGE	
	Sub Total £	

Any other works not itemised (please detail)		
1		
2		
3		
4		
	Sub Total £	
	Total to form Tender	

Signed:
Position Held:
For And On Behalf Of:

Authorised Extra Work

Should any extra work or variation be required at day work rates, we undertake to carry out the work at net cost plus the following percentage additions to cover supervision, establishment charges and profit for work performed during normal hours.

Materials..... %

Sub-contract work..... %

Plant..... %

Labour rates for dayworks are also to be submitted, to be priced as fully inclusive hourly rates for the various standards of labour.

Labour rates: -

Schedule of Rates

Upon the client's request, the Contractor shall provide **within 7 days** a 'Quantified Schedule of Rates' covering the entire installation. **Lump sum** rates of any form will not be acceptable.

This schedule shall be based on the same prices as those used to comprise his Tender and shall be used to value any omissions or additions to the Contract.